My Thoughts on the War by Maj. Alexander de Seversky

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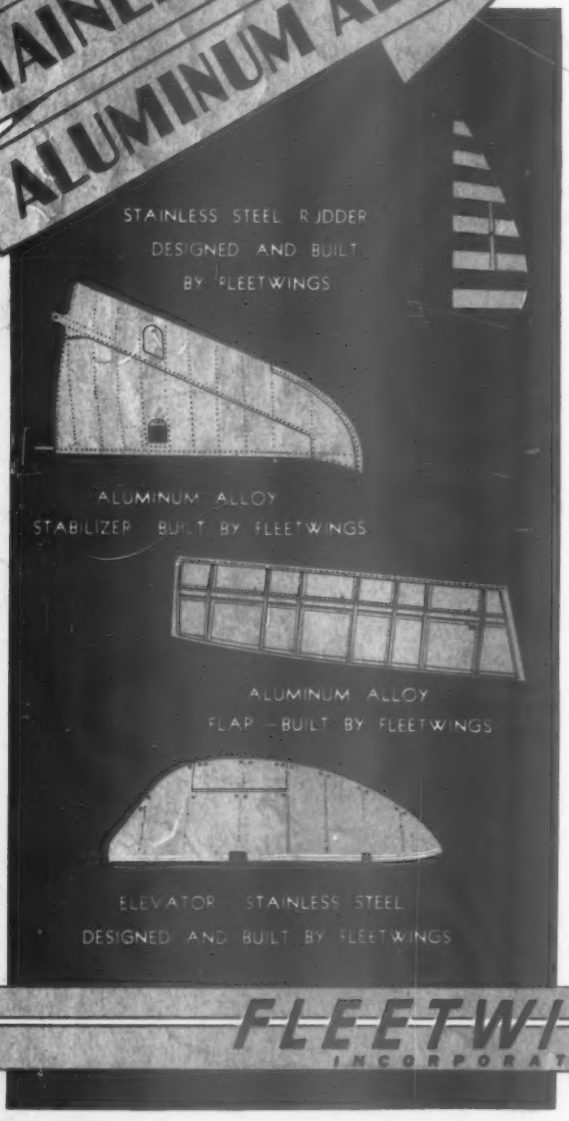

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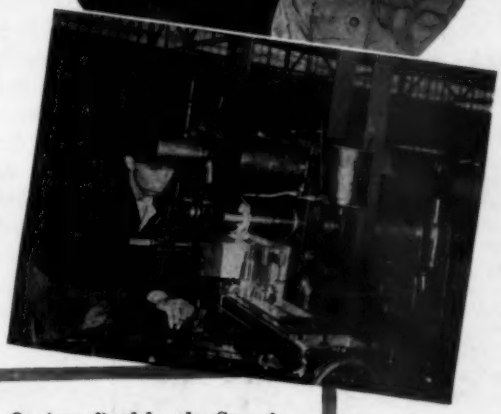

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SPENT a week on the east coast just before starting work on this issue. Stopped through Washington to visit the Air Corps' excellent exhibit at Bolling Field. Then up to Baltimore for a day of watching Martin build bombers for the French. On to New York for a look at Sweden's batch of Republic fighters, a preview of the Navy's newest mid-wing fighter at Grumman and instruments and gadgets galore at Sperry. Made the rounds out on Long Island in a borrowed Stinson "105" and gave Grumman's test pilot his first ride in a lightplane. Dinner one night with the Zack Mosleys, followed by a preview of "Smilin' Jack's" adventures up to about April 1 (which we promised not to reveal). A look at LaGuardia's Peep Show (10 cents a peep) while waiting for our airliner, then four hours of comfort, good food, reading and listening to the radio as we flew over blizzards, homeward bound.

* * *

WHILE our ship was letting down for a scheduled stop at Pittsburgh, we found ourselves cooking up a smoke abatement scheme in which aviation might play an important role. As we flew over the smokestacks that have belched Pittsburgh into the position of one of the dirtiest cities in the country, we wondered why some enterprising newspaper couldn't send one of its photographers out in a plane to get good close-ups from the air of the offending smokestacks? Chicago's just as bad; we might experiment with the idea here after this issue's off the presses.

* * *

JOTTED down two interesting items concerning the Army Air Corps. From at least five unrelated sources we heard detailed descriptions of what the Army currently is experimenting with: Air Corps engineers have mounted a 75 mm. artillery piece in a twin-engined B-18A bomber for tests. The ship was at the Bolling Field exhibit, covered with tarpaulins. . . . The other item also concerned the Bolling Field affair. Out on the field's apron the Army had every type of airplane it owns on display. Each was marked with a poster. Somehow, the Army boys got the posters on the Waco and St. Louis trainers switched. We pointed out the mistake. "Huh," grunted the sentry, "they're not my airplanes so what's the difference?"

* * *

IT WAS one year ago that we started our monthly "I Learned About Flying From That" series. Pilots, instructors, insurance men and schools have

(*Continued on page* 93)

POPULAR AVIATION
Trade-mark Registered

Volume XXVI April, 1940 Number 4

Contents

FEATURES

Pocket Battleships of the Air 10
Warrior 13
Cubs' Den 14
My Thoughts on the War 18
Seaplaning Is Fun! 20
Yankee Yeomen (full page photograph) 23
If I Designed a Family Airplane 24
So I Went Gliding 27
The D Ships 28
Heads Up, Soldier! 32
Book Bug 35
Doctrine of Ruthlessness 36
Fires Can Be Prevented 38
Flight Surgeon 40
Next Stop—the Front 43
Warbird Depot 44
WPAirports 46
Plain Planesmen 49
I Learned About Flying From That!—No. 12 51
Worst to Best 52
Lilliput Lab 54
AOPA News 57
Retractable Landing Gears 59
Have You Seen? 60
Model Building Tips 62

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The Birdmen's Perch

Back in December we promised to print an Honor Roll of those Perch fans who sent in solutions to a "tricky" (or so we thought) problem. We expected answers by the dozen . . . *we got hundreds!* The partial list below is only the beginning; next month we hope to print the balance. We're mighty happy though somewhat stunned by the whole business. *Congrats to all!*

"Tattered Wing-Tips," Editor, The Birdmen's Perch, Room 3800, Gulf Bldg., Pittsburgh, Pa.

ONCE BITTEN . . . TWICE SHY DEPT.

Below is a problem sent us by George W. Prediger, of Valhalla, New York. If you'd like to know the correct solution, we'd be glad to mail it to you.

Important, N.B., Attention. We will not contract to publish an Honor Roll on any problem from now on. Forever. No kidding. Even if it has no answer. You are much too smart. The next time we would

probably have to move off the Perch to make room.

At a recent air meet there were assembled 100 planes of three sizes.

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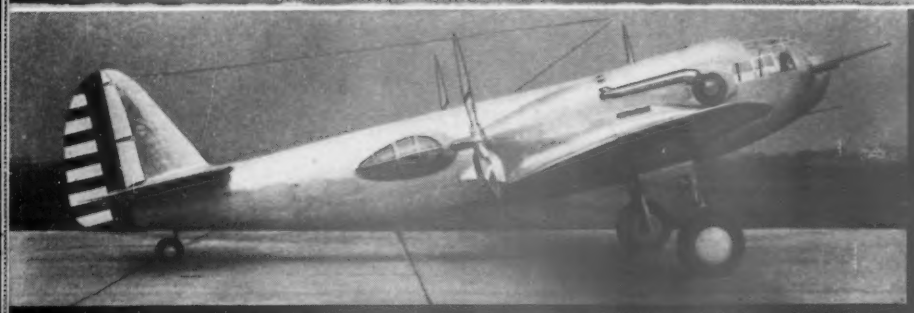


Probably the first true battleship of the sky is the American Bell "Airacuda" above. Two pusher 1,000 h.p. Allisons give it 350 m.p.h. Armament includes two rapid-fire cannon and four machine guns.

Eagerly being watched by experts of the world is this radical twin-engined (2,000 h.p. total) Lockheed P-38 single-seater. Heavily but secretly armed, it is now in production for the Army Air Corps.

The French currently have two "battleship" types in use. Above is 270 m.p.h. LeO "45", three-place fighter-bomber. Below: Breguet "690", a 267 m.p.h. fighter. Armament includes two cannon.

CURTISS *Hawks* and Hawker *Hurricanes*, Messerschmitt Me-109's and Supermarine *Spitfires* have been streaking across newspaper front pages since World War II began. Yet, when air historians tomorrow write the story of the war in the air, they will have to give first place to another type of fighting plane. It has hardly appeared yet and has been mentioned only in the most mysterious terms—the twin-engined fighter, pocket battleship of the air.

Germany has at least one—Willy Messerschmitt's design number 110—in action only a few times so far. France has a trio—Breguet, Hanriot and LeO—though enemy eyes have had no look at them. England has only a makeshift—converted *Blenheim* bombers—but more must be on the way. Alert neutrals are building them: the late Anthony Fokker's Holland company; Uncle Sam's Air Corps in the form of the Lockheed P-38 and Bell XMF-1.

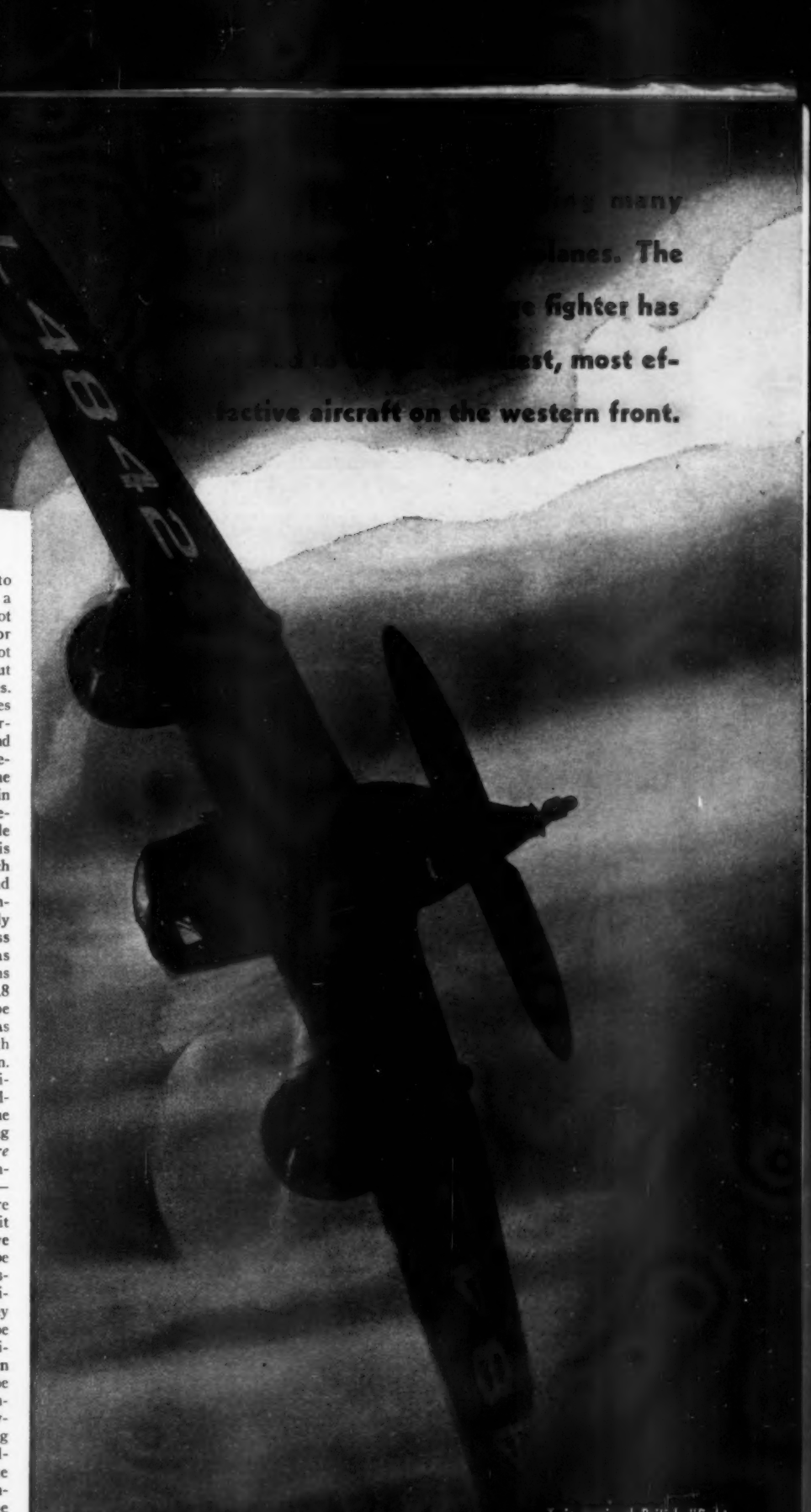
The single-engined single-seater is king of the heap at the moment, particularly when it is eight-gunned and fast like the *Hurricane* and the *Spitfire*. But the war is producing a demand for guns and more guns on a plane and designers say they have about reached the limit with the single-engined ship. They have turned to two engines to carry the arsenals that mean victory aloft.

The term "twin-engined fighter" actually covers a wide variety of war craft, ranging from single-seaters, like the Fokker D-23 and Lockheed P-38, up to big jobs with crews of three to five men, like the Bell *Airacuda* and the Me-110. France's twin-engined fighters are almost attack bombers on the American style. The French call them fighter-bomber-reconnaissance monoplanes; that gives you the idea. The Breguet 690-1, for instance, can almost be considered to be three types of the same basic plane, and its equipment is varied with the job it is to do.

There are a great many reasons why the designers are thinking more and more about the twin-engined fighter these days, most of them connected with armament. Eight Browning .303's with 600 rounds of ammunition for each gun weigh more than 600 pounds—and that is just about the limit of weight than can be set aside in a plane powered by an engine in the 1,000 h.p. class. Putting in a single 2,000 h.p. engine—the next step in single-seat single-

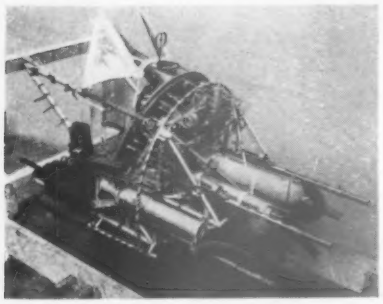
engined fighting planes—is not going to increase the allowance for armament by a tremendous amount. It probably will not increase the weight allowance enough, for the trend is not only toward giving a pilot the greatest volume of fire possible, but more particularly to increase gun calibres. French Moranes and American Curtisses used by the French have a plate of quarter-inch steel armor beneath the pilot and behind his back—enough to stop rifle-calibre machine gun bullets. Higher plane speeds mean also that warplanes are in range for less and less time. The rifle-calibre machine gun has a range of little more than 300 yards. The alternative is mounting heavier guns, firing .5 inch armor-piercing or explosive bullets and larger. But the weight of the gun, ammunition and accessories increases rapidly with calibre. A single .5 inch gun and less than 250 rounds of ammunition weigh as much as two rifle-calibre machine guns with 400 rounds apiece. A 20 mm. (.8 inch) cannon of high muzzle velocity type alone weighs about 110 pounds, as much as two ordinary machine guns complete with ammunition for 400 rounds from each gun. The Army Air Corps is already experimenting with a 37 mm. (1.5 inch) rapid-fire cannon for aircraft. This gun alone weighs more than 400 pounds. Getting down to cases, a plane like the *Spitfire* cannot mount more than two 20 mm. cannon with about 100 shells between them—in other words, the plane might lose more in all-important volume of fire than it might gain from using more destructive shells—that is, if the weight that can be allowed for armament remains of the present order. Thus the interest in the multi-engined fighter, in which engineers, if they are not already doing it, will some day be putting half a ton of guns and ammunition. Even if the rifle-calibre machine gun does remain in use, rates of fire will be increased steadily, necessitating larger ammunition supplies and larger weight allowances. Vickers and Browning guns firing at the rate of 1,500 rounds a minute already are in service. The Belgian Fabrique National, which turns out Brownings under license, already has a Browning-type gun firing 1,800 shots a minute.

Weight of armament is by no means the only consideration. Europe is abandoning the gun firing in between the propeller blades. The widespread use of three-



Twin-engined British "fighters" actually are converted Bristol "Blenheim" bombers.

Dutch aerial battleship is this Fokker G-1. Two 850 h.p. engines are used. Range is 1,270 miles.



Fokker D-23 is twin-engined fighter. Below left is elaborate armament of G-1.

bladed propellers cuts down the rate of fire. The wing gun is therefore widely used. But wing guns have their disadvantages, too—the gun is inaccessible to the pilot if the gun jams. The guns are not supposed to jam and they do not very often—machine guns are far more reliable today than they were 25 years ago, but jam they do. With a conventional twin-engine arrangement the guns can all be grouped in the nose. Not more than four can be put in the nose of a single-engined machine, whereas eight at least can be put in the nose of a twin-engined ship.

Still another advantage of the twin-engined fighter is the easier installation of a tricycle landing gear. Stowing the nose wheel is a nuisance in a single-engined plane unless the engine is pushed back and the propeller run on an extension shaft, as in Bell's ingenious little P-39. Some engineers also argue that it should be possible to get more speed from a twin-engined ship at any given stage in air development where speeds hover around the 400 m.p.h. mark; plenty of equally weighty engineers, however, register a hearty nay to this proposition. On the other hand, the pilot of a twin-engined machine does not have his engine in front of him as a very effective bullet-proof shield (true also of the P-39, of course), nor is visibility quite so good to the sides, though it can be improved by shoving the cockpit as far forward as possible.

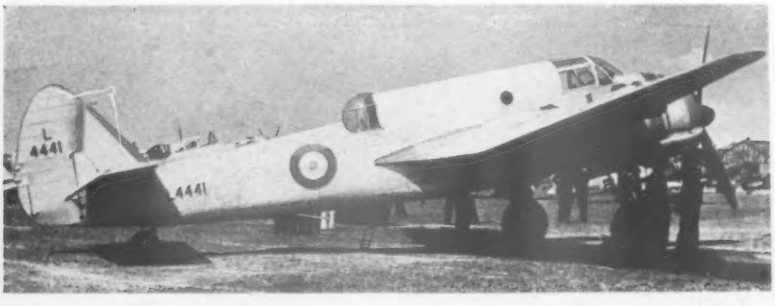
So Europe's interest in the twin-engined fighter. The present belligerents' warcraft in this class are pretty closely guarded secrets, but we "outsiders" do know a little about them. The Me-110, few photos of which have ever gotten out of Germany, has a pair of Daimler-Benz 601A engines. Its speed is in the neighborhood of 350 m.p.h. It is actually almost as large as the Dornier Do-17 bomber. Crew is supposed to be three and armament two 20 mm. cannon and four .312 inch machine guns.

France's Breguet 390-1 has been tried out with several sets of engines, speeds ranging from 310 to 340 m.p.h. as a result. Armament details unknown, but it certainly includes the beloved French 20 mm. cannon when the Breguet is to be used as a fighter. Service squadrons of the Armee de l'Air are now getting Hanriot 220s; they carry a pair of 20 mm. cannon and two rifle-calibre machine guns (crew of two); top speed 340 m.p.h. Liore et Olivier, builders of the 11-ton LeO "45" bomber which does more than 310 m.p.h. despite its size, tried out a 370 m.p.h. twin-engined fighter at Villacoublay just before the war and it must now be in production.

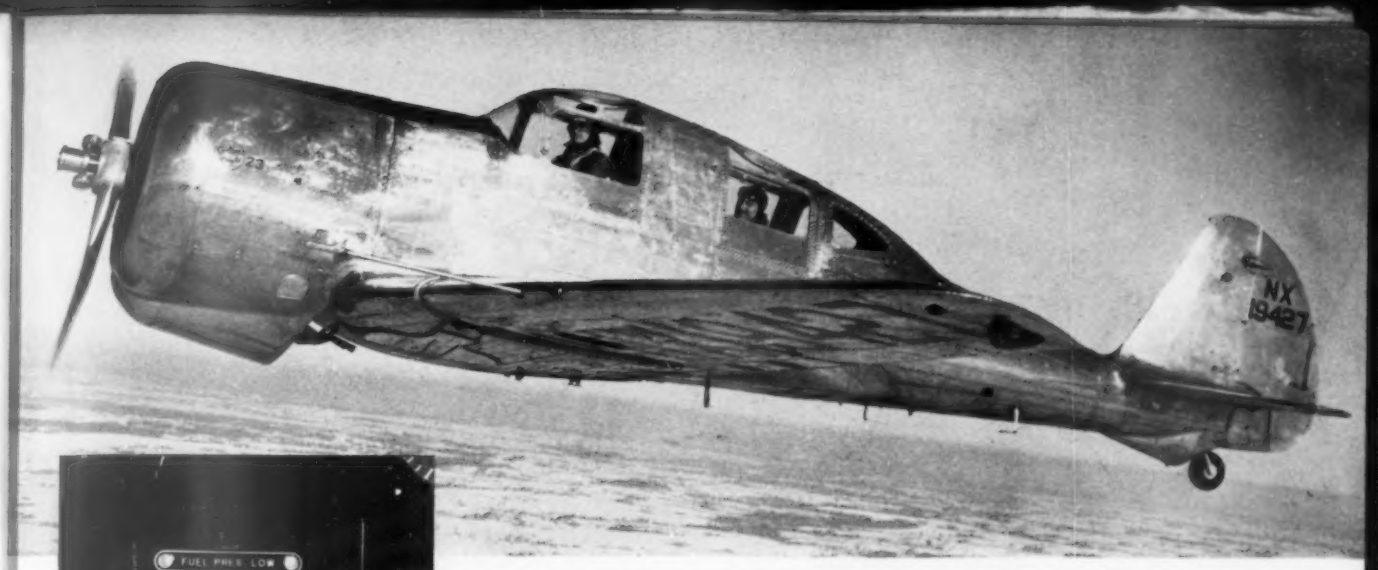
The French planes are very nearly similar to the Martin and Douglas attack bombers in general characteristics and performance (though not, of course, in structure). Which indicates that the attack bombers could be adapted, despite certain technical difficulties, into very ac-

(*Continued on page* 88)

Newest British product is the Bristol "Beaufort", a heavily armed twin-engined monoplane. It is said to be in production in England and Australia for the Royal Air Force.



The U. S. Army Air Corps is trying this 37 mm. gun.

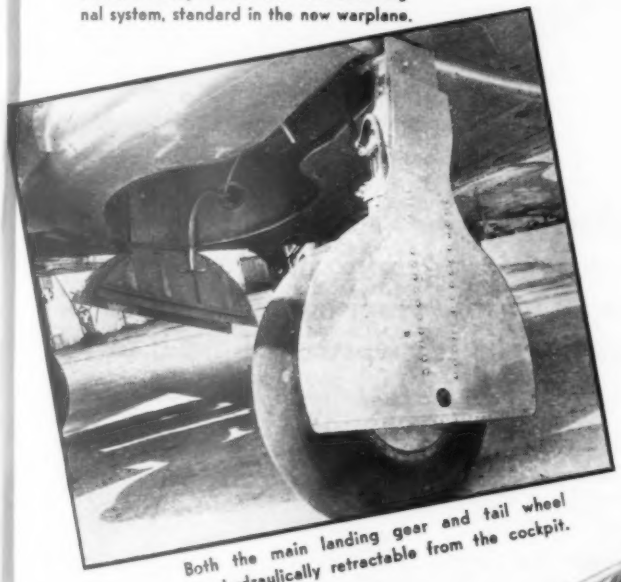


In level flight, top speed of CW-23 is 325 m.p.h. Rate of climb is over 3,000 f.p.m.

Novel development is the "Tell Tale" signal system, standard in the new warplane.

WARRIOR

CAPABLE of climbing more than 3,000 feet per minute with a full military load, the Curtiss-Wright CW-23 illustrated on this page probably would make a better interceptor fighter than Britain's much-touted Supermarine *Spitfire* and Hawker *Hurricane*. The *Spitfire* climbs 2,290 feet per minute; the *Hurricane*, 2,400. Developed primarily for export, the CW-23 is generally patterned after a design being developed for the U. S. Army Air Corps. The CW-23 is powered with a *Cyclone* engine of approximately 800 h.p. and has a maximum speed of 325 m.p.h. Armament consists of six machine guns. Optional features include equipment combinations for attack gunnery, aerial photography, light bombardment, radio communications and long range reconnaissance missions. A novel feature of the CW-23's equipment is the Curtiss-developed "Tell Tale" signal system installed in the cockpit for the simplifying of the pilot's duties. The system immediately calls the pilot's attention to improper operation of some vital part of the ship and identifies the affected part. The panel, illustrated at left, contains seven sets of lights; a novel test button locates burned-out lights. The rear cockpit has dual controls, a machine gun and sliding hatch.



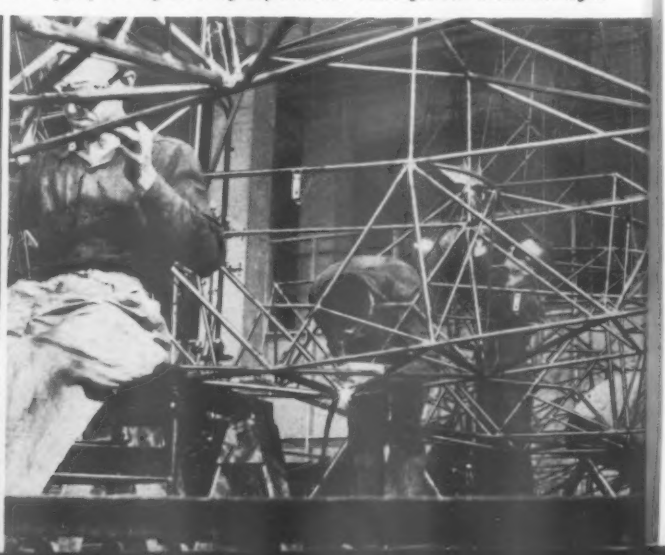
Both the main landing gear and tail wheel are hydraulically retractable from the cockpit.

The CW-23's cockpits are notably closed and faired.

Another "Cub" comes out for test flying.

More airplanes roll through Piper factory doors daily than are produced by any other aircraft plant in the world. It's worth looking into.

Below (left) is wing covering department. Fuselages are welded at right.



FOLKS like to call Bill Piper "The Henry Ford of Aviation." Henry Ford's factories jammed the highways with low-priced, economical road flivvers at a time when automobile prices were high and automobiles were only for the well-to-do. Bill Piper's factory is doing its bit to crowd the sky with flocks of low-priced, economical and safe sky flivvers, the Piper *Cubs*.

Bill Piper—he is William T. Piper on his business cards and official documents—is president of the Piper Aircraft Corporation of Lock Haven, Pa., which builds about 60 per cent of America's commercial airplanes. As such, Bill Piper and his company have virtually revolutionized the flying business, knocking its high costs into a cocked hat, and introducing thousands of new flyers to the business.

Piper's big factory at Lock Haven is turning out about one new ship for every 70 minutes of working time. That's about 10 ships a day or 50 to 60 a week—in all, about 1,806 in 1939—which is really *production* when it comes to airplanes. More new pilots are being trained today on Piper's planes than in all other makes combined. More folks are being taken up in Piper's ships for their first flights and more new pilots are buying Piper's ships than all others put together.

When the Civil Aeronautics Authority started to train about 10,000 new pilots in the colleges last fall, most of the new fledglings started their training in Piper *Cubs*. The Army figured that only about one-tenth of the youngsters who learn to handle the flivvers will be material for advanced training and ultimately may become army flying officers—and the *Cub* training is enabling the Army to single out this one-tenth cheaply and safely and efficiently.

Quite an amazing story is that of Bill Piper and the Piper Aircraft Corporation of Lock Haven. It starts 59 years ago in January, 1881, at Knapp's Creek, N. Y., near Bradford, Pa., where Piper was born. Knapp's Creek is in the heart of the Bradford oil fields and virtually everyone dabbles in oil. But not Piper. He wanted to be different, became a construction engineer and built the foundations for the United States Steel Corporation's huge pipe mills at Lorain, O., in 1903.

Scenes like this are common at the Piper factory. Production at present is running approximately 10 completed airplanes daily, more than any manufacturer in the world.

But oil had too strong a hold. He quit the construction business, went back to Bradford and for years prospered in the oil business. Then came a couple of youngsters with a dream: C. Gilbert and Gordon Taylor. They had built a plane called the Taylor *Chummy*, a side-by-side job, and proposed to build a factory. That was the "Lindbergh era", 1928, when anything connected with aviation brought out a flood of capital. All Bradford was enthusiastic—that is, all Bradford but the oil man, Piper. He was unimpressed. But not even the death of Gordon Taylor in a plane crash dampened Bradford's enthusiasm. The Bradford Board of Commerce began soliciting stock subscriptions to help out the new airplane company, to be known as the Taylor Brothers Aircraft Company, and a solicitor called on Piper's partner, R. C. Lloyd.

"Sure," Lloyd told the solicitor, breezily, "put me down for a couple of hundred dollars' worth of your stock." As the solicitor started to leave, Lloyd added:

"Say, by the way, you'd better put down Bill Piper for a couple of hundred dollars worth, too."

So it was only by accident that Piper became connected with the company. He was amazed when he learned that he now was a stockholder in the new concern. Then one day Col. A. S. Burns, a man with whom Piper had served in the Spanish-American War, rode to town with Bill.

"You," said the Colonel to Piper, "ought to be on the airplane company's board."

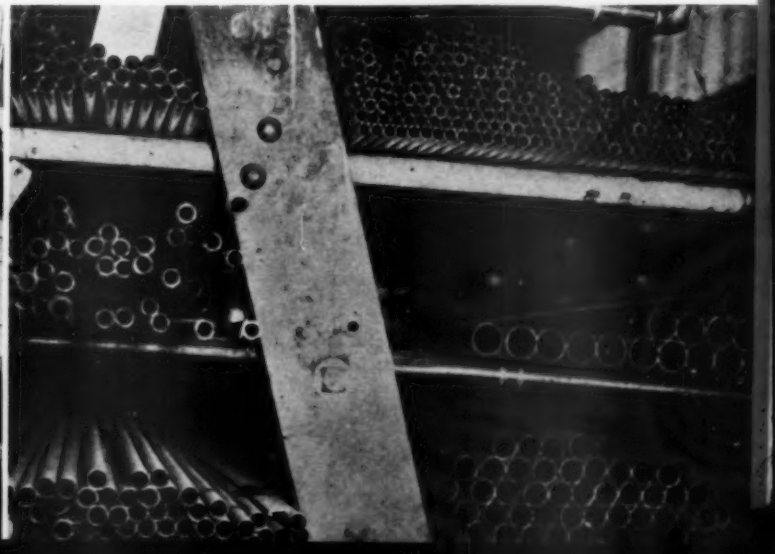
"Go on," scoffed Piper. "What do I know about airplanes?"

But in due time, he was on the board. Then he became treasurer, pouring more and more of his own money into the company as he became interested in it.

Finding the *Chummy* to be too expensive for the average plane owner, Piper urged Taylor to design a cheap airplane, one that was low in cost of building, cheap to operate—and safe. The first *Cub* was built in 1930. George W. Kirkendall, who now calls himself No. 1 *Cub* pilot, attempted to fly the ship on September 12, 1930. But it didn't perform so well. Powered with only a 20 h.p. engine, the little ship got six feet off the ground, then settled back. But Taylor and Piper weren't discouraged. They cast about, finally found a little nine-cylindered air-cooled Salmson engine which did the trick. So was born the *Cub*, the *Cub* of today which since has had a lot of refine-

Below is final assembly, with five "Cubs" ready to roll off the line. Piper's assembly line is similar to motor firms'.

Tubing is cut for 200 airplanes at one time. Stacked in racks, each part is painted a color that identifies it from other sizes.



Shrewd advertising policies help keep Piper in the lead in lightplane sales. Piper advertisements are pointed at the average layman, rarely at the aviation industry. Pictures like this emphasize "Cub" utility.

ments and improvements. It got its first approved type certificate June 15, 1931.

The new "putt-putt" wasn't a howling success at first. Pilots were skeptical of the new-fangled plane and derisive of its low speed, contending the price still was too high and that *Cub*-trained pilots weren't really pilots and . . . well, they found plenty of fault.

So only a few ships were built in the little factory building at Bradford the first year, a few more the second year and still a few more the third year. Then pilots suddenly discovered that *Cubs* were pretty good little ships at that, were real money-makers and brought down flying costs. Newly-trained pilots were enthusiastic and the orders started rolling in.

Additions had to be constructed at the factory to handle the business—but not everything was well at Bradford. Piper, the practical, shrewd businessman, clashed with Taylor, the temperamental engineering genius, over company policies. Taylor sold out, leaving the whole plant in Piper's hands. For the time, the company continued to bear Taylor's name.

Orders continued to pour in. Then, just at the height of the rush (1937) a disastrous fire swept part of the ramshackle Bradford plant. Piper hurriedly scoured the town, renting all available warehouse space for assembling *Cubs*, and the work went on as best it could. Piper finally located a huge vacant factory building—a former silk mill that had cost $800,000 to build—at Lock Haven, a slumbering little town of 10,000, and bought it for about $95,000.

"Now," he said, as the company got settled in the new location, "we've got plenty of room for expansion—for all the expansion we're likely to have for some time anyway."

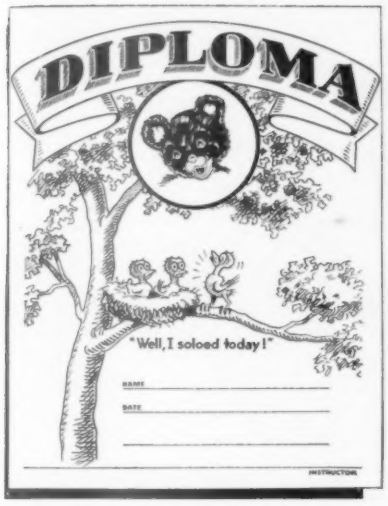
But Piper had guessed wrong. In 1937 the factory built 700 *Cubs*. In 1938 it built 730 *Cubs* and in 1939 it built and delivered 1,806 airplanes, establishing a new record in the civil airplane industry. In 1940, well, the sky's the limit. Already the big factory, with two floors and 500 employees, is crowded to the limit. Piper himself predicts 1940 production will exceed 2,500 machines—with that limit set only by the plant's capacity. Just a hurried glance at Piper's 1939 production figures: of the 1,672 ships produced up to December 16, 1,156 were two-place 50 h.p. trainers; 52 had 40 h.p. engines; 342 had 65 h.p. engines; 97 had 55 h.p. engines; 21 had 60 h.p. engines and four had 75 h.p. engines. Of the 1,156 50 h.p. jobs, 730 had Franklin engines, 220 had Continentals, 199 had Lycomings and seven had Lenapes, while the 65 h.p. jobs all had Continental engines and the 40 h.p. jobs also all had Continental engines. The 55 h.p. models all were Lycoming-powered, as were four 75 h.p. engines. There were 21 Franklin 60 h.p. ships.

Piper's factory really rang the bell all spring, summer and fall during 1939. Here's the factory's monthly output during the year: January, 44; February, 68; March, 85; April 117; May, 189; June, 157; July, 177; August, 205; September, 182; October, 189; November, 195; and the first two weeks of December, 64.

Piper's 1940 models now include the 40 h.p. trainer that sells for $995, but which Piper no longer is trying to push; the 50 h.p. trainer that sells for about $1,300 depending on the engine specified, and the refined 65 h.p. *Coupe*, which comes either with the 65 h.p. Continental or Lycoming engine and is priced at $1,910 to $1,995; and then the new *Cub Cruiser* which is attracting so much attention. The *Cub Cruiser* is three-place and is powered either with a 75 h.p. Continental or a geared Lycoming 75 h.p. engine. It sells for $1,798, complete with dual ignition, brakes, compass, navigation lights, tailwheel and 18-gallon gasoline tanks.

Soon a two-place amphibian of about the same weight, speed and power, and costing $2,500, will be put on the market by Piper. Designed by Ray Applegate and known as the *Cub Clipper*, the test ship already has been attracting attention with its landings in the Susquehanna

C. G. Taylor (right) is the father of the lightplane. Below is one of the original "Cubs", still flying.



Good promotion is this "diplome" given each tyro who soloes—a "Cub", of course.

River, not far from the Piper plant.

Just a word about this fellow Piper. He is as common, easy-going and comfortable as an old shoe. His suit looks as though it was tailored for the plant janitor or someone with a better shape; his hat looks as though he had slept in it. He shuns a private office, occupying a big desk in a corner of a big office which he shares with Ted Weld, the vice president, and his secretary.

A genial, easy-going fellow, he's the life of the parties the Piper company frequently gives for its dealers. He knows all his workmen by their first names. He takes a personal interest in their home lives, their jobs and especially in their flying. Everyone knows him simply as Bill or the Boss and they know he's usually good for a "touch" in a pinch.

Sometimes he gets mad. Then he orders everyone out of his office until his temper cools off. But his employees are accustomed to his ways and moods, they hold no grudges and greet him pleasantly as he strolls through the factory. Piper learned to fly at the age of 50—incidentally, taking his first lessons in one of the first Taylor *Chummies* and finishing off in one of the first *Cubs*. He got a private license but has since dropped it, taking a solo rating. He flies 150 to 175 hours a year—almost all of it in *Cubs*. When he makes a long trip he usually flies out with a *Cub* trainer or sport, leaving the ship with a distributor and returning to the factory by train or airliner.

"We've got to get those ships out to the far places," he explains, "and flying them out is our best method. I might as well do my part." Only a few months ago, he flew a 50 h.p. *Cub* in leisurely jumps across the continent to California, up the Pacific Coast to Washington, visiting distributors and agents along the way. Then he took the ship back to California and delivered it to a hard-pressed distributor.

Piper is one of five pilots in his family. Two sons—William, Jr., and Thomas (known as "Tony")—hold commercial ratings. Another son, Howard, holds a

(*Continued on page 92*)

W. T. Piper (left) shares his office with two other people. Here he confers with W. B. St. John (center), factory sales manager; and Ted Weld, vice president. All are pilots.

Alert for new ideas, Piper soon will place the first cheap amphibian (above) on the market. Piper engineers also have tested slotted and flapped taper wings (below).

The U. S., recognizing need for a bomber-destroyer, developed the Bell "Airacuda".

The Seversky P-35 combines many theories set forth by the author in this article.

IF HISTORY (to resurrect an adage) has a way of repeating itself, it is no better exemplified than in the feverish race now going on among the European belligerents to design better military planes. The conflict between Germany on the one hand, and France and England on the other, may be a continuation of the "war of nerves" so far as public morals is concerned. It may be cunning pitted against cunning so far as international politics is concerned. It may be blockade against counter-blockade so far as an assurance of supplies is concerned. But the war in the air goes right back to the point where the First World War left off—a fight for supremacy in design, which means supremacy in performance.

While men have talked of production capacities with a gravity indicating that they thought mere numbers would win a war, the real battle has been fought over drafting boards. New categories of planes and sub-divisions of old categories, are in the making. The United States, recognizing the need for machines which would deliver a death blow to an enemy bombing squadron, created the Bell *Airacuda*, the bomber-destroyer. And now, more than two years later, a Europe plunged into a new blood bath is fighting frantically for air superiority by creating similar types. Witness France's Breguet, designed to attack bombers.

As I watch the flow of news from Europe, I draw unconscious comparisons between the problems of the great war a quarter of a century ago and the problems facing the belligerents today. It was obvious in the former war that bombardment aviation, unprotected by fast fighters, was easy prey for defending pursuits. Repeatedly Russian pursuit aviation had to turn over the protection of Russian bombers to Providence during that hazardous flight over the Baltic bound for Germany. For the entire distance the air was patrolled either by German or by Russian pursuits. Our pursuit aviation would match the bombers, mile for mile, for perhaps half the distance to the bombers' objectives. Then the pursuits, their fuel supply limited, would wheel about and return to their bases.

The bombers from that point were on their own. Our bombardment aviation suffered the consequences. The casualty rate was high. And—with history repeating itself—the casualty rate today, as the British attempt to raid Helgoland or the Germans attempt to strike at the English east coast without the benefit of a protective covering fire from accompanying fighters is, I dare say, just as high. Speeds have increased. Guns are better. Avigation has become a fine art. But the principle of protection for bombardment aviation remains unchanged.

The conflict in Europe (or the conflicts, if we are to include the Finnish-Russian war in the picture) has disclosed that bombardment aviation has appallingly weak defensive armament. Not only have the high commands dispatched their airplanes on missions without protective escorts; they have failed to provide them with sufficient numbers and calibers of guns to fight off the planes seeking to destroy them. Last summer I had the opportunity to inspect the German Heinkel bomber. Except for one forward gun, I was surprised to find only two machine gun positions in the ship, one on top of the fuselage capable of being swung in a relatively narrow arc and one below to meet attacks from the back and below. I found only one bomber in Europe with worse gun protection in combat. That was the tri-motor Savoia Marchetti in Italy. For all practical pur-

MY THOUGHTS ON THE WAR

by MAJOR ALEXANDER P. de SEVERSKY

Major Seversky

One of the most famous military aircraft designers, recently back from Europe, has many interesting facts to write about

poses that bomber's top machine gun had no forward fire at all. It was so badly installed that, in order to command the area immediately in front of the ship beyond the nose motor, the gun had to be accommodated by nosing the ship down.

In defensive armament I believe the British bombers rank first and American bombers second, with France and Germany tied for third. The ease with which the British have been shooting down units of German bombardment missions tends, it seems to me, to substantiate this. But efforts are being made now to correct obvious faults of design. Guns are being re-positioned. I believe that defensive armor must be fitted to certain types of bombers, even at the expense of a sacrifice in speed.

Faults of design on the one hand and good design on the other will, I am convinced, play a profound role in the European struggle for supremacy in the air. I need not point out, in passing, that actual "control" of the air exists only in the imaginations of the Sunday supplement writers. In the midst of the magnificent job which the German air force did in Poland last September, Polish flyers were able to take to the air and escape with their airplanes across the border. But air superiority is another and highly important matter. From it stems all manner of advantages to the side possessing it. Photographic and reconnaissance aviation can speed the movement of troops and supplies and can serve to halt offensives even as they are a-borning. Attack aviation can harrass war-weary troops until their morale is shattered. Bombardment aviation can wreck communication lines, ammunition centers and munitions factories.

If the Allied reports of signal successes against German Messerschmitt fighters are to be taken at their face value, I believe it has been due entirely to a fault in German design. Certainly no one will challenge the ability or the courage of the German airmen. The story has been circulated that the high speed Messerschmitts are out-maneuvered. On the contrary, I believe the Messerschmitt single-engine fighter is more maneuverable and faster than any other fighter in Europe save one—the British Supermarine *Spitfire* which, incidentally, I had the opportunity of flying.

The trouble with the Messerschmitt, being corrected now, produced one of the most valuable lessons of the war to date. The engineers placed the only fuel tank, a large one, immediately behind the pilot—a perfect target for a rear attack. Even if the fuel is not exploded, one bullet through the tank will flood the cockpit with raw and suffocating gasoline. I discovered this deficiency of design when the German air force favored me with a demonstration of the Messerschmitt's performance last June at the Orlie works in Leipzig, southwest of Berlin. A mere technical fault apparently has been accountable for many losses. The fault, I should like to emphasize, was one only from the military point of

(*Continued on page* 86)

"My conclusion was that the 'Spitfire' is the best all-around fighter in use . . ."

The modern float-equipped airplane offers the private flyer endless hours of pleasure that cannot be experienced with a landplane

A YEAR or so ago, Mr. Richard Archbold, his pilot Russ Rogers, and a smart little crew had a job of work to do—something about high altitude exploration and load carrying in wild country—so they took a flying boat seaplane and flew there. They did the job and flew home. Simple, just like that.

Dick Archbold said it was simple. They merely flew non-stop across this country, landed a couple of times on the way across the Pacific and disappeared into

the wilds of New Guinea. When the job was finished they ambled across the Indian Ocean where no plane had ever flown before, hit only the two coasts of Africa, and crossed the Atlantic Ocean at its very widest part making their landfall at the Virgin Islands because they wanted to stop there on the way home.

They had no landing field information in six four-pound volumes three years old with corrections in pencil. In fact, they hardly thought about landing. They just went where they wanted to, which happened to be around the world at the equator. They had a seaplane which, with a fair amount of range built in, affords a traveller just about open sesame

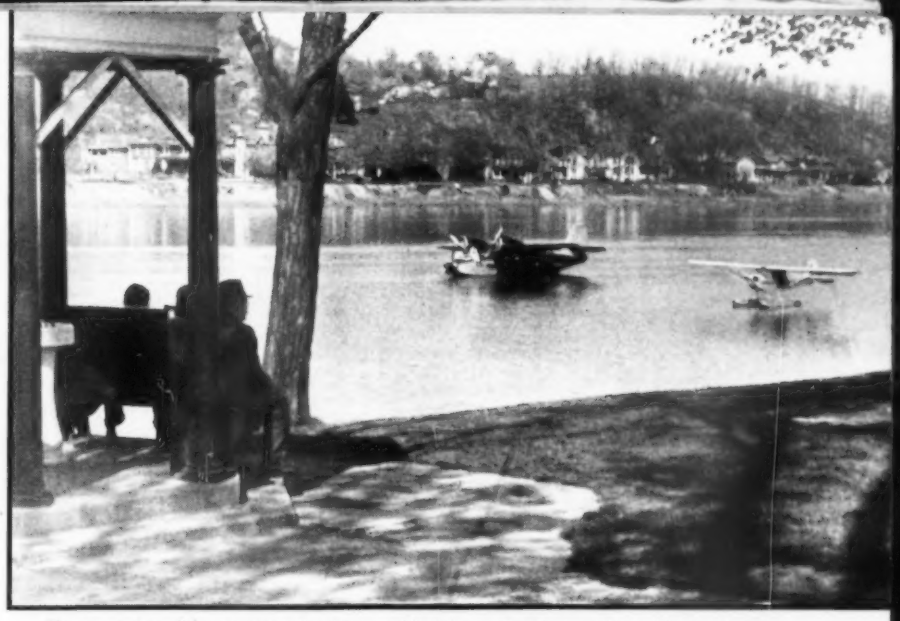
Franklin T. Kurt

to every part of the world he wishes to poke into.

Theirs was the big Consolidated patrol type flying boat *Guba,* but on the other end of the scale Henry Chapman of New Orleans flew home from New York non-stop in his *Aeronca* seaplane, "because it was practical and the floats made an excellent reserve fuel tank." (See POPULAR AVIATION, December, 1939.) What more reason should be needed than that?

The most significant feature of these two flights—and, indeed of all seaplane operations—is the utter matter-of-factness of the whole thing. Nowadays, airports are looming larger and larger in the consciousness of the average groundling citizen. He points them out to his children as they motor along the road and often they turn in on a Sunday afternoon to watch the flying. He reads about their cost and the political battles that rage over them and he absorbs some conception of the type and the amount of flying that is done off the land. But he never sees the seaplane flying. It is out of sight and out of mind. Seaplanes are not concentrated anywhere. Yet, they *are* everywhere!

They are the life blood of Canada and Alaska—not merely express or mail carriers, but the actual bulk freighters. Their useful load is determined solely by the amount the plane will drag off the water; it is always terrific, as we know loads. Tropical muddy rivers in a dozen countries are now major airways. A doctor in Borneo with an American light seaplane lands in a river so overgrown with trees that meet overhead, that he has



The town river, lake or reservoir offers an ideal haven for the seaplane. The pontoon-equipped "Cub" above is as much at home as the big, expensive Grumman amphibian.

Florida is the seaplane pilot's paradise. Several seaplanes flew to Miami and St. Petersburg from northern states as part of the recent lightplane cruise to the south.

an entrance hole he dives into for his landing and, after take-off, he flies around the bends and through the tunnel until he comes to another "zoom-out" hole! A couple of twin-engined amphibians are in the oil business on the Gulf Coast. The average length of their flights is only six minutes. Back and forth between oil wells out in the water, shore bases, supply centers, pumping stations, and loading docks they ply with payrolls, casing heads, the big-shot, a box of cigarettes and the daily paper, or perhaps a stretcher case for cargo.

Greatest users of all are the American private flyers who are turning to the seaplane in geometric increase. A whole ring of bobbing commuting planes is usually waiting its indvidual turn to dock at either of the two New York municipal seaplane bases any summer morning at nine or in the afternoon at five.

There are now some 400 privately-owned seaplanes in the United States and about a hundred more licensed for commercial use. This is a gain of approximately 100 percent in the past four years. Generally speaking, it costs about 25 percent of the cost of a landplane to buy floats, corrosion proof it and convert it to a seaplane. Unfortunately, it is more than this in the lower price classes, because there is almost as much work in making a small set of floats as a large set.

Twelve hundred dollars will purchase and install a new pair of floats for a modern lightplane of 65 h.p., but don't think that you are entering such a strange new endeavor when you embark with a seaplane. Although seaplaning is to landplaning as motor-boating is to automobiling—and it is different and vastly more appealing—it is just as simple and is still flying pretty much the way you know it already.

We'd like to explode this bunk about its being difficult to learn to handle a seaplane. While an initiate has no business trying to dock in a congested space, we see no reason why he need attempt it. All he has to learn in order to start is how to throw an anchor and the important thing there is to remember to hold onto the end of the rope—and also to give it enough scope so that it will hold firmly. Now he is ready to seaplane anywhere he wishes in well settled country and not one whit more experience is needed. We say "settled country" because he must choose a place—a yacht club or a friend's home—where some one will row out for him, but it is really hard to find a place on an American waterway where a small boy and his skiff won't be waiting under the wing by the time he's anchored.

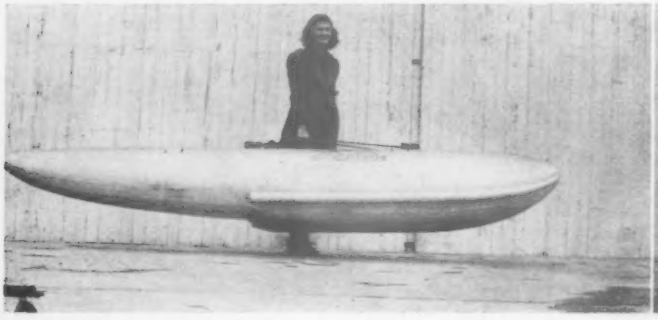
A half hour will cover the little frills of take-off and landing differences and both are easier and subject to more leeway in carelessness than for landplanes. There is only one other important thing to learn or, rather, know. The initiate must remember that all seaplanes are designed only to operate from one relatively sheltered body of water to an-

(*Continued on page* 64)

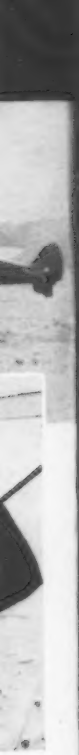
The Hicksville (N. Y.) Aviation Country Club does much to promote seaplane cruising (top). Inset are Members Grover Loening, Mrs. and Mr. Robert Love and the G. B. Posts.

The seaplane on land is not an unusual sight these days. Many such landings and take-offs have been made as stunts, actually are highly practicable for all flyers.

Newest innovation in the seaplane field is the McKinley inflated rubber pontoon. Soon to be placed on the market, it is light and durable.



Standard dural pontoons also are obtainable with built-in retractable wheels. Their price, however, is prohibitive.



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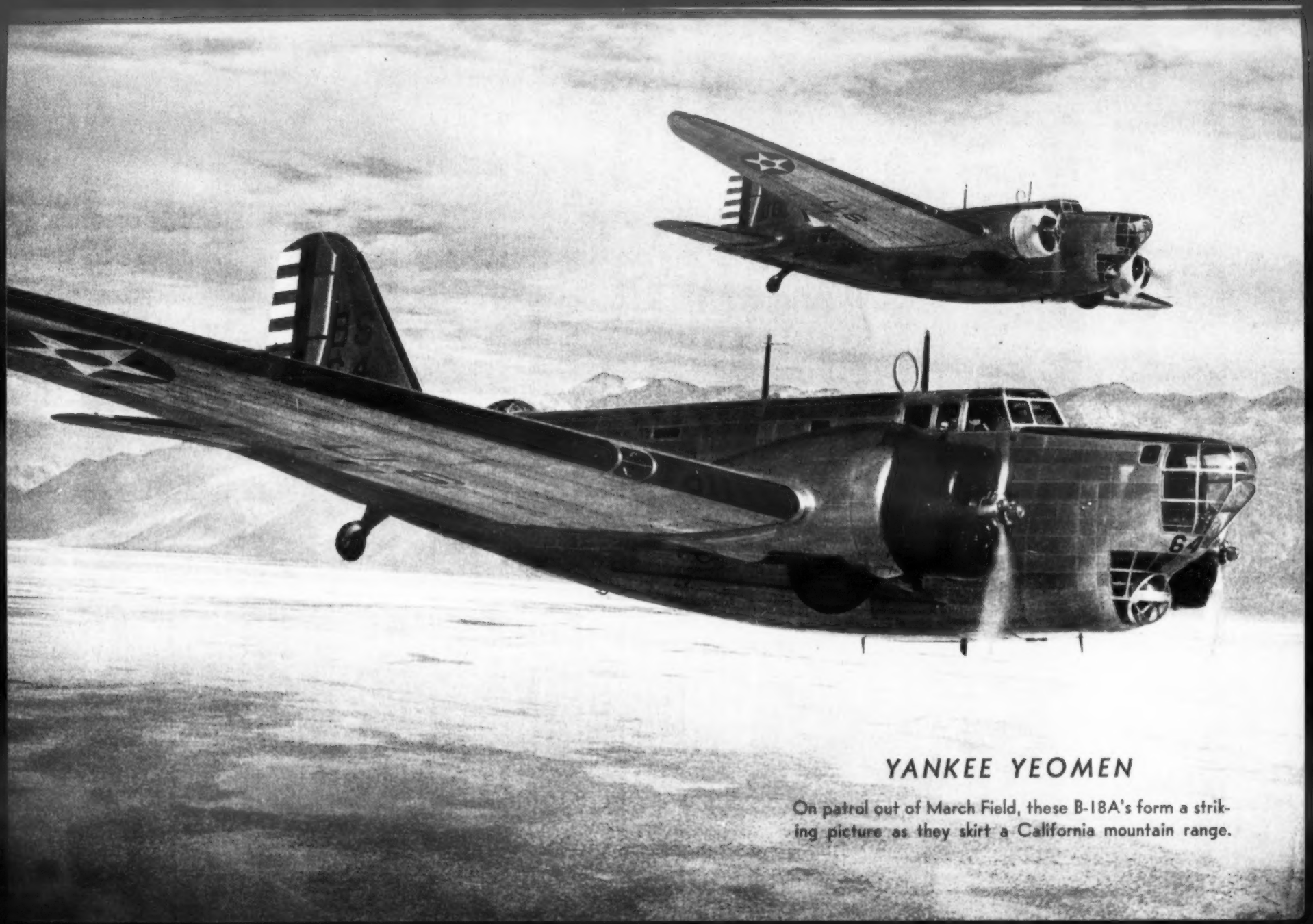


YANKEE YEOMEN

On patrol out of March Field, these B-18A's form a striking picture as they skirt a California mountain range.

IF I DESIGNED A

Hall L. Hibbard

By HALL L. HIBBARD

Chief Engineer, Lockheed Aircraft Corporation

A famous designer of famous commercial and military aircraft takes a few moments to contemplate another type plane

FROM the standpoint of design and production of the light airplane, the effects of the present Army Air Corps and Civil Aeronautics Authority training programs will be far-reaching. Not today, nor tomorrow, but some time in the near future, these programs are going to cause some large corporation to undertake the greatest gamble in aviation history. Within five years many of those now learning to fly will be in the market for a light or, better, "family" airplane.

This will not be the light airplane as we know it today but a larger, faster plane. As an engineer, I would estimate its horsepower at 300, its speed at cruising 200 m.p.h. or better, its capacity five persons and its gasoline consumption in automotive terms about 12 miles to the gallon. A ship of this type will be the lightplane, or standard plane, of tomorrow for several reasons which I will discuss later.

I have said that some large corporation will gamble. Note that I have not said that some designer will gamble. Let's blow up one of those popular fallacies right now. The fallacy is that some backyard designer, working on his own somewhere out in Podunk Corners, will suddenly give birth to an economical, cheaply constructed, super-safe and fast-flying airplane. The training courses are gradually building up a market. The big manufacturers of automobiles and transport airplanes know it. They also know that when the time comes to go, they must go in a big way. They must have a huge factory, fully equipped with tools and dies such as automotive manufacturers have now. They must have punch presses, drop hammers, turret lathes and other modern mass-production facilities. And they must produce from the start between 50 and 100 modern planes a day.

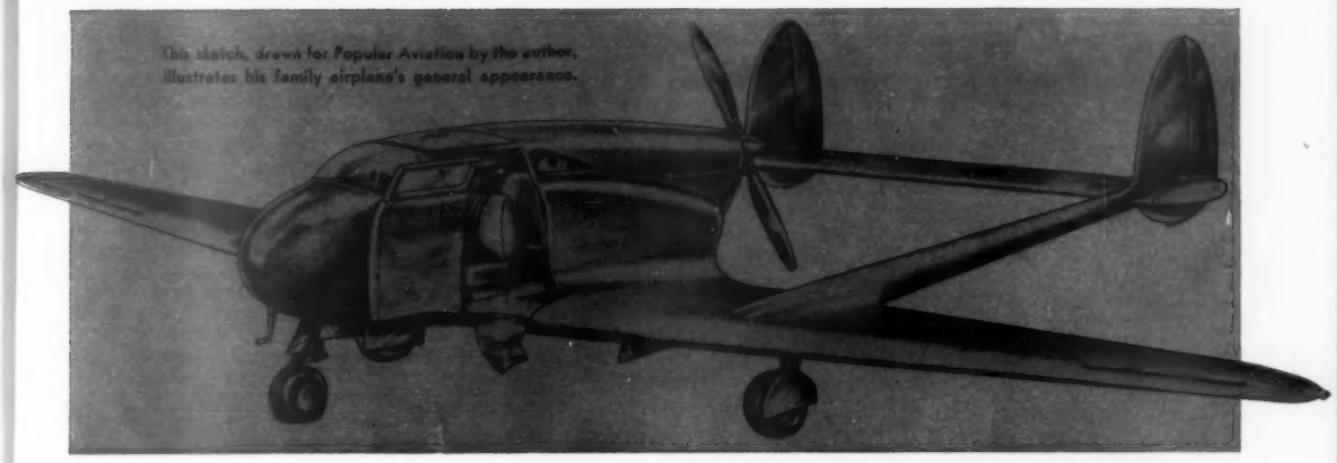
Obviously no back-yard builder is going to produce such an airplane. Furthermore, to disillusion you again, we designers and engineers know that there is no such thing as a super-safe, fast airplane. There is no such thing as a fast, economical airplane. And, unless this new manufacturer we talk about plunges in head first with a tooling cost of several millions, we are not going to have an airplane which will meet the demands of the average flying man and at the same time sell at a reasonable price.

Why will a man want a family airplane? Because he will want to take at least four people with him (81.48 per cent of all automobiles built in the U. S. in 1938 had seats for four or more persons). This dooms the two-passenger job right off. We designers will have to make it comfortable, giving him an interior equal to an expensive automobile interior. He will not want a ship which is covered with something somebody is apt to put an elbow through at any moment. And, above all, he will want a fast airplane. If an airplane won't get there any faster, or just a little bit faster, than an automobile why, he will argue, buy an airplane.

These are just a few of the designing problems which face me, or anyone who thinks of designing such a ship. Why is there no such thing as a fast,

"I would use flaps, of course. The extension flap gives greater lift and actually increases wing size."

A FAMILY AIRPLANE



This sketch, drawn for Popular Aviation by the author, illustrates his family airplane's general appearance.

economical airplane? Because you pay for speed. While you don't pay so much in the air as you do on the ground, remember that resistance squares as you add speed and that the need for power is cubed. Drive your car 35 m.p.h. and you get 18 miles to the gallon. Drive 60 and you get 12. Tires, parts, everything pays a penalty for that added speed.

The Quixotic quest for a super-safe fast airplane has been going on for years, yet we designers know that there is no answer. Airplane design is a matter of compromise. Load your ship with gadgets to make it safe and you slow it down. Take off the gadgets and you go faster. And, before we specifically discuss the airplane I would design, let's quit kidding ourselves about the super-safe airplane as a whole. While engineers and designers are using natural laws, knowledge, history, research and horse sense building transport airplanes, there is always that fellow dreaming it up, as they say, in a garret or a cocktail bar or a woodshed.

"Some day," he says, "airplanes will be so safe that the average man will walk into a show room and, without experience, take one out and fly it."

That will never happen until the law of gravity is repealed.

You can't go into a display room and drive an automobile off the floor without any previous experience, furthermore, *no* mechanical thing is safe. Continuing with the automobile, you can get behind the wheel of one and, within a block, kill yourself. You can do this by skidding and overturning, by crashing into a wall, another car or anything handy. The automobile and the airplane both have their limitations and we have to respect them—unless we want to commit suicide.

There are certain safety factors to be considered in the light airplane I would design. First of all, designing transports has taught me the need of two motors. I would not want to design an airplane which would glide gently to the ground on only one motor. I would want to use a motor which would climb my airplane. I would want it to carry me over any obstructions in my way higher than my elevation and to my destination safely, although at a slower speed. Frankly, I will not fly in a single-motored airplane and would not ask either a friend of mine or a customer for my family airplane to do so.

I would call for two motors of 150 h.p. each. Transport designing has taught me that it would be advisable to hook these two motors together in the nose of my ship rather than separate them and put them in the wings. Why? Because my "family flyer" will be safer, for his power will still pull him straight ahead instead of forcing him to "crab" along. Because I can design a cleaner, faster ship with just a nose to streamline instead of two nacelles. Definitely, the Unitwin principle will give a safer, faster airplane. It will result in economies, too, with only one mount, one propeller, a simpler instrument panel and one set of control channels in my plan. Frankly, too, I toy with the thought of designing my plane with the motor behind, pushing the airplane. I consider this because of increased visibility. There are other small factors. However, I would weigh the matter carefully.

The material? I think I would experiment with plastics. But I feel confident that if I did I would return to metal, which I have learned to use as a designer of transports. All manufacture turns to metal and the aircraft industry is leading the parade. However, my mind is completely open and I will know within a year or so what will be best for my needs.

What safety devices would I use? Flaps, of course. Flaps have proved themselves on transports. The extension flap gives greater lift than the drop flap because it actually increases the size of the wing. Therefore, I would embody the extension flap. This would give me a slower landing speed. My "family flyer" will want to land as slow as possible so as not to alarm grandma.

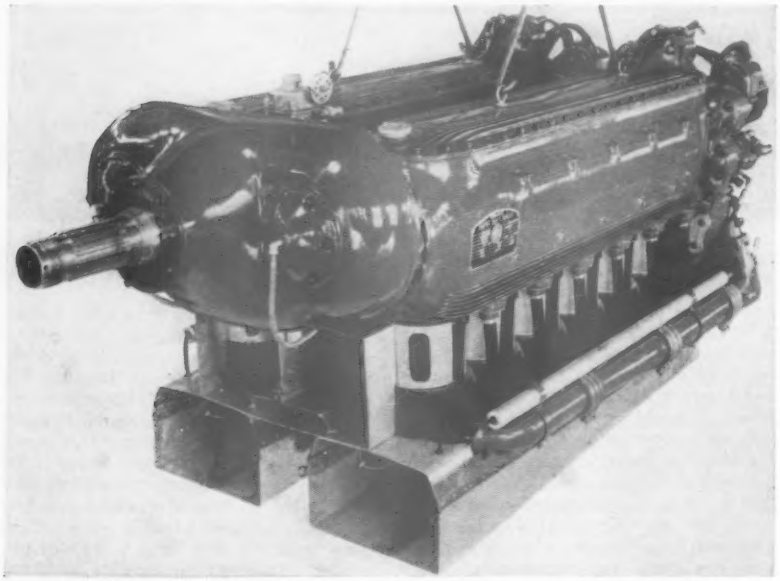
Slots? No. Perhaps, in view of the success of the new fixed wing slot pioneered in transport design by Lockheed, this comes as a shock. However, although it is valuable in larger ships and even in light airplanes, I believe I can design an airfoil which will have excellent stalling characteristics—so good, in fact, that slots will not be necessary. And, because I am trying to keep costs down, I will put nothing on my airplane which has no definite value.

Of course, there will be a nose wheel. This nose wheel will be one of the biggest "sales talks" for the ship. Transport design has proved without a shadow of a doubt that a nose wheel increases the safety of any airplane, large or small. It is my prediction that all ships will have one within the next three, or at most, five years. It affords greater visibility both on the ground and in the landing attitude. With flying increasing constantly, this will become more and more necessary. It eliminates ground-looping, a source of constant minor accidents with resultant weakening of structure. And, above all, it eliminates the dangers of cross-wind landings.

In this connection, one of the thoughts I have been playing with is the removing of wings. Then the airplane could be driven to the owner's home. I fear that this is on the fantastic side and

probably always will be. But one of the main obstructions to the growth of the use of the light airplane by private owners is the necessity of going to an airport. With the use of the nose wheel and the resultant elimination of cross-wind landing hazards, I feel confident that the airport problem will be solved by highway landing strips. Narrow, say 100 feet wide, they would be comparatively inexpensive. They could be about 3,000 or 4,000 feet long. They could be equipped for service. And they could run in any direction the road did and be available in any normal wind, no matter in what direction it might be blowing. The square airport, covering many acres, would be used as a base, but the highway strip would allow for convenience.

The controls of my airplane will be simpler than those existing at the present time. It is possible, I am sure, with a light airplane to eliminate the rudder pedals, yet retain the rudder, which will be essential. I would design my ship so that rudders and ailerons would function together in a coordinated manner. This would result in pilots learning to fly with greater ease. Simplification of the business of flying an airplane is one of the problems we face. Particularly in the lightplane field.



"I would want two motors of 150 h.p. each, built in one unit on the 'Unitwin' principle (above). I can design a much cleaner ship with just the single nose to streamline."

My wing I would place low. It would be at the base of the fuselage. I might compromise and make it a mid-wing job. I would choose the low or mid-wing installation rather than the high wing for two reasons, both learned in the course of designing transports. The first is safety in case of forced landings. It is better to have the wing beneath you absorb any shock than to have the fuselage take it with the weight of the wing resting on top of it. The second is the ease of installing retractable landing gear.

The retractable landing gear is essential. In the case of my 200 m.p.h., 300 h.p. family airplane I would add 25 m.p.h. to the cruising speed by using retractable wheels, including the nose wheel. The main reason why only a very few builders of light or private planes, have installed the retractable landing gear is its expense under the present system of what amounts to hand fabrication. Under mass-production methods, the cost would be much less per unit.

I have been emphasizing the fact that transport design would be of great help to me in designing the smaller plane. I feel confident that I am not exaggerating when I say that my family airplane will cruise at 200 with 300 h.p. in spite of the fact that one of the most efficient of today's private airplanes, costing more than $25,000, delivers a little better than 200 with a 400 h.p. motor. The retractable landing gear is one reason. Clean design and the use of metal would be another. The ship will have no struts of any kind, no wires. The incorporation of transport principles will have much to do with it—the application of things which we have learned in building the big jobs.

What of manufacturing this plane and its motor? I have pointed out the absolute need of millions of dollars worth of tooling before we start, plus the need for a production of from 50 to 100 planes a day. Recent experience in turning out the *Hudson* bombers for England has shown us that we are still using complicated methods of producing intricate equipment when simpler objects would serve as safely and as well. For instance, I don't believe that the time will come when we can press out a whole wing for our family plane. But we could stamp out a leading edge, for instance, fit in our ribs and braces

(*Continued on page* 91)

Sikorsky Helicopter

IGOR SIKORSKY, aviation pioneer, has aroused local interest with a specially designed helicopter which is being test-flown at the Bridgeport, Conn., airport. The helicopter, designed by Mr. Sikorsky, is powered by a 65 h.p. engine which drives a huge three-bladed propeller located over the pilot's head. It is distinguished from the conventional craft of this kind by a small, single-bladed propeller which Mr. Sikorsky has mounted on an outrigger in the rear of the ship. This rear propeller revolves on a horizontal axis as does the customary airplane propeller.

Mr. Sikorsky's recent trip to Germany where experiments with helicopters have progressed further than in this country is believed to have fired his imagination with the idea of constructing a better helicopter in the United States. The construction of this type of aircraft is by no means a novelty to Mr. Sikorsky, however, as his first airplane, built and flown in pre-war days before the famous "winged-S" series, was also a helicopter.

Aviation's Status

THE following table has been compiled for POPULAR AVIATION readers by the Civil Aeronautics Authority and will be included in all subsequent issues if readers so indicate. Figures in this table are as of January 15:

Pilot certificates of competency, active	31,264
Airline pilot certificates of competency, active	1,197
Student pilot certificates, active	33,032
Glider pilot certificates of competency, active	170
Mechanic certificates of competency, active	10,296
Certificated aircraft, active	12,829
Uncertificated aircraft, active	943
Certificated gliders, active	44
Uncertificated gliders, active	177
Schools holding certificates of competency, active	49
Ground instructors certificates of competency, active	446
Total airports (including 80 Army and Navy fields)	2,280
Total seaplane bases and anchorages (including 16 Army and Navy bases)	171

Millions for Research

AMERICAN aircraft, engine and propeller manufacturers spent $44,000,000 on research and development during the past five years. This amount, according to the Aeronautical Chamber of Commerce, is 63 per cent more than the industry's net profit for the same period. The chamber's survey included 37 manufacturers. Gross sales of these for the 1934-38 period were $468,000,000, of which the $44,000,000 spent for research and development represents 9.4 per cent. The industry's aggregate profit, after paying $12,000,000 in taxes, was $27,000,000.

SO I WENT GLIDING...

by EDWARD CHURCHILL

A novice tries his hand at the mysterious but fascinating sport of flying without an engine

Editor's Note: In the March issue, Mr. Churchill told of the organization of the Southern California Soaring Association and its rapid development during the past four years to a membership of 125 representing ownership of between 15 and 20 gliders. Harvey Stephens, motion picture player and first vice-president, suggested that Churchill accompany him to Rosamond Dry Lake, where most of the winter gliding is done. During the day, Stephens asked the writer to take up his single-seater Bowlus "Baby Albatross" sailplane. The flight, followed by others, inspired this article on a tyro's reaction to the controls.

WHEN you go gliding you get up at 5:30 a. m. Before you glide, there are lots of things to be done. This winter morn I met Harvey Stephens, first vice-president of the Southern California Soaring Association. We picked up Howard Morrison, an enthusiast, and Stephens' sailplane at the Bowlus factory at San Fernando.

Rosamond Dry Lake is 80 miles from Los Angeles. The sailplane was neatly stowed on a two-wheeled trailer for the trek. In the center was the fuselage with its long boom. The wings were mounted to a point, like the sloping sides of a house roof. Tail surfaces and struts were tucked away beside the fuselage. The trailer was covered with tarpaulin to keep out dust. This is the standard mobile unit when you go looking for thermals.

At Lancaster, 60 miles out, we stopped for breakfast. We met Don and Virginia Mitchell and Glenn Robinson, members of the Salt Lake Gliding Club. They, too, were using their sailplane—another *Albatross.*

"A good trailer," Harvey told me, between bites, "costs from $50 to $100 if you make it yourself."

You can spend anywhere from $100 on a home-made primary glider which you can put together in your woodshed to $2,500 for the sleekest of sailplanes.

Twenty minutes later we were at the lake, which is nearly round and about three miles in diameter—perfect for towing. The surface is smooth. The nearest hills are five miles away.

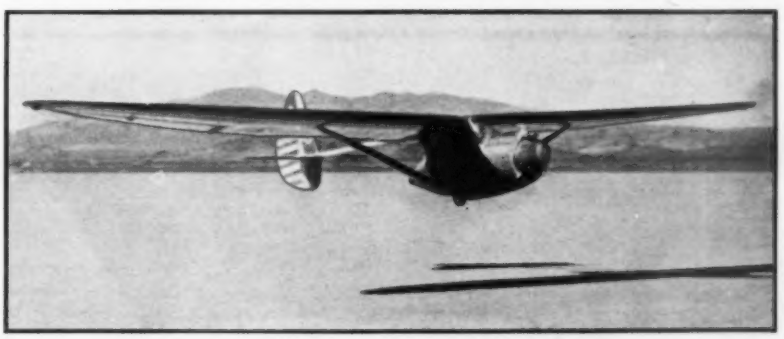
Harvey explained as we unloaded under a cloudless sky:

"There won't be thermals today. We seldom find them in winter. So we'll just glide."

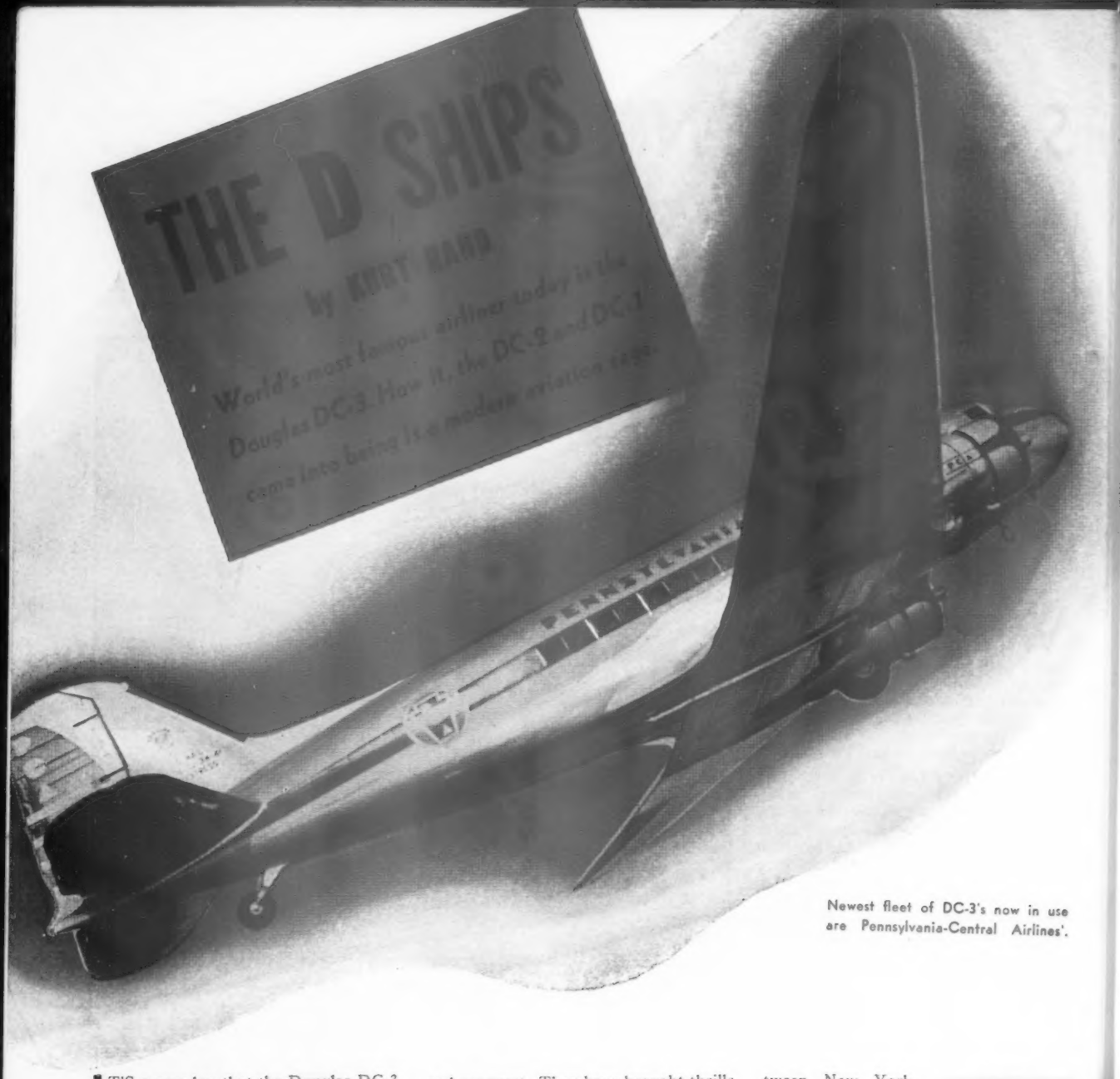
We spent 20 minutes setting up the glider. We laid the wings on the ground. We put the fuselage between. Then we got the tail surfaces. It was assembled

(*Continued on page* 74)

The author (in the cockpit) gets a few last-minute pointers from Harvey Stephens.



The "Baby Albatross", with the author at the controls, lands on Rosamond Dry Lake.



Newest fleet of DC-3's now in use are Pennsylvania-Central Airlines'.

IT'S a paradox that the Douglas DC-3, the world's greatest airliner, was born on a railroad train. You don't stretch a point too far when you say this happened. True, the outgrowth of that historical train ride of perspiring Douglas officials from Los Angeles to Kansas City was the DC-1. But the DC-2 was the DC-1 with 20 inches added to her fuselage. Add to span, horsepower and barrel your fuselage and you have today's DC-3.

Donald W. Douglas, president of the company which makes the famous planes, who supervised every detail of design and construction of all models and then flew with his pilots and engineers on test flights, says:

"I never think of them as D-this or D-that. I think of them as transports."

The D-ships, particularly the DC-3, have appealed to the American imagination, the American spirit of pioneering and conquest. They have brought thrills, romance and color to this modern world. All America knows the reassuring roar of the motors of American Airlines' *Flagships,* Eastern Airlines' *Great Silver Fleet,* United Air Lines' *Mainliner,* TWA's *Sky Chief,* and the sleek cruisers of other air transport companies. Throughout the world other magic names are linked with Douglas transportation—names such as Cia de Aviacion, S.A., Mexico; Pan American and Pan American Grace; Airlines of Australia and Australian National Airways; Air France, of France; Avio Linee, Italiane, Italy; K. L. M., Netherlands; Japanese Air Transport, China National Aviation System and many others.

The Douglas transports have given America international records. D. W. Tomlinson, now a TWA executive, shattered 12 international and several American records on a triangular course between New York and Washington in 1935 and established a coast-to-coast mark that same year by flying from Los Angeles to New York City in 11 hours, 5 minutes and 45 seconds, introducing the "robot" pilot.

Donald Douglas

A Douglas won the London-Melbourne race in 1934.

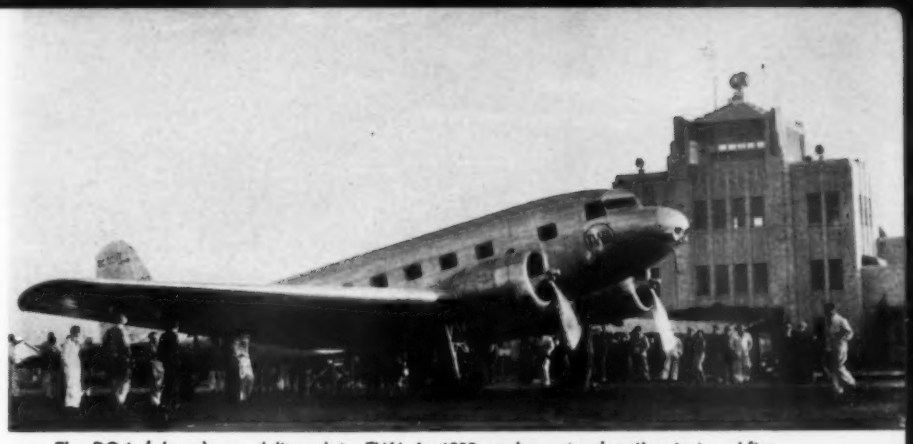
In the great Ohio flood of 1937, Douglases brought in medical supplies, food, clothing and bedding, landing on water-logged fields. Later they took out the ill and injured, as many as 30 to a plane. They repeated later, when the hurricane struck New England in 1938, winged messengers of

mercy to the stricken. They've done everything from aiding in the study of cosmic rays five miles above the earth to carrying college football teams to famous battles and movie stars across the nation for strike conferences.

There was only one DC-1, known as "good old 300" to the men who designed, built, flew and tested her. She was later sold to Howard Hughes, millionaire sportsman flyer and now is owned by a San Francisco business man. Douglas built 138 DC-2's, selling them for a total of $15,180,000 and has built to date 260 DC-3's, bringing in a total of $32,750,000. In all, that's $47,930,000. There is a backlog of 60 ships today, amounting to $7,500,000. Figure in Army and Navy modifications and the sales will amount to considerably more than $100,000,000.

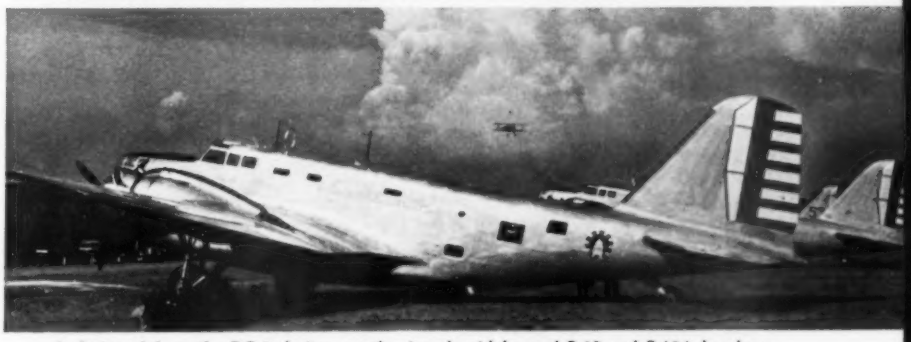
There will be more DC-3's built. But inside of a year—18 months at the outside—the plane will step down from its position of eminence to make way for four-motored, faster ships. In production soon will be Boeing's "307," known as the *Stratoliner;* the Curtiss-Wright "20," Lockheed's *Excalibur* and the modified DC-4. At the beginning of this year Douglas announced orders for 39 of the latter from American Airlines, Eastern Airlines, United Air Lines, Pan American and K.L.M. TWA announced late in 1939 the placing of an order for six of the *Stratoliners.* Yet today and for a long time to come, the shadow of the DC-3 will continue to fall on every nation on this globe. Each day the great ships travel a distance equal to 17 times around the equator.

The DC-1 came into being for several reasons. First, in 1931 Ford discontinued the manufacture of his trimotors. Jack Frye, president of TWA was casting around for a better ship. Douglas production of the *Dolphin* amphibian and the Army O-43A's and O-46A's was slack. Frye and Douglas talked over the needed ship. Douglas started the fateful train ride early in 1932. He called in the late Harry Wetzel, his right hand man, production expert and economist and Arthur Raymond,



The DC-1 (above) was delivered to TWA in 1933, underwent exhaustive tests. After carrying 4,000 passengers, it was sold to Howard Hughes, then to another operator.

The first DC-2 still is flying TWA routes. It was delivered on May 15, 1934, has flown 10,000 hours and has been completely rebuilt three times. Douglas sold 138 of these.



Redesigned from the DC-3 design are the Army's widely used B-18 and B-18A bombers. The Army as well as the Navy and Marines also use standard DC-2 and DC-3 transports.

Common sight at any major air terminal today is a large number of DC-3's being loaded or unloaded.

This is the DC-3 production line at the Douglas factory. Costing approximately $110,000 each, more than 260 airliners of this model have been built and delivered.

Douglas' able assistant chief engineer.

"Jack Frye wants an aerodynamically sound transport, more economical, faster and able to carry a greater payload a greater distance than anything on the market," he told them. "Take a train to Kansas City. Work on the way. Then tell him your ideas and get his."

Frye was elated with what they showed him when they arrived. He made changes and alterations, looking at the problem from a standpoint of maintenance. And the DC-1 12-passenger airliner, rolled out of the hangar into the hands of "Tommy" Tomlinson of TWA and Edmund Allen, Douglas test pilot.

"The amazing thing about the ship," Ed Burton, chief designer and assistant chief engineer of Douglas, says today, "is that although it was newer, larger and radically different, we had few problems of design. The model, tested in the wind tunnel at California Institute of Technology, performed well. We ironed out minor wrinkles."

Tomlinson says:

"I flew the DC-1 in exhaustive tests, both experimentally and over the TWA route. It was nothing short of marvelous. I worked for five months, putting 200 hours on the ship. We took delivery on December 1, 1933."

Much of Tomlinson's research went into the subsequent development of the DC-2 and DC-3. So good was the DC-1, after a few small bugs were taken out, that Tomlinson worked only a month on the DC-2 tests. Harlan Hull and Walt Hamilton, who tested the DC-3, report that from the beginning it was the smoothest job they'd ever flown.

"We gave the DC-1 the works," Tomlinson relates. "The first one-engine test was made from Winslow to Albuquerque with a full load of 18,000 pounds.

Arthur Raymond

Halfway down the runway at Winslow we cut one engine and climbed without any trouble to 8,300 feet, a thousand feet higher than any point on our route. Later, both DC-2's and DC-3's performed this test on all routes, including the Salt Lake City-Cheyenne run. which has a ground elevation of better than 9,000 feet.

"We landed with what we estimated to be 'two thimbles full' of oil at Albuquerque. This called for minor changes in the oil circulation system, but that was all."

Tomlinson didn't pull a punch during the tests. He recalls:

"On one early test Allen and I took off from Glendale with an overload for a one-motor flight. The propeller tips were not six inches off the field all the way down the runway."

But the ship took it. A number of tests were made with the retractable landing gear. A positive latch to lock the gear in "down" position was not a part of equipment on early flights and Tomlinson twice landed the plane on its belly without the slightest damage except bent propellers. The tests developed the landing gear to a point where it now is practically perfect in its action.

In the DC-1 Tomlinson made what he believes was the first "instrument" or blind take-off. He promised to leave Glendale for Kansas City for its first run at a certain time and the field was fogged in. He could see a black line on the runway and used that to guide him down the runway.

"Douglas came along on many of the test flights," he says, "to find out at first hand the way the ship handled in the air."

Below are two standard DC-3 interiors. That on the left is the day-plane arrangement of a sleeper compartment. At right is the interior of the 21-seat version. This is most widely used by the airlines.

Harry Wetzel

The use of a motion picture camera was used to check torsional and vertical deflections of the wings under various loads and conditions. The camera was mounted in the cabin and focused upon two vertical scales mounted on the top of one wing tip, the scales being set about a yard apart in a fore and aft plane. A cross hair placed in front of the lens served as a horizontal reference line. A second 16 millimeter motion picture camera was mounted in the cabin and focused on the top of the outer wing and center section. The equipment was completed with a Navy type visual accelerometer and a V-G recorder to measure the severity of loads imposed during maneuvers or air bumps.

"The deflection of the wing was compared with the deflection which had been calculated for the loading and the two were in agreement within four-tenths of an inch," Tomlinson says. "The actual deflection was less than calculated by the wind tunnel experiments."

After Tomlinson finished his tests the DC-1 carried 4,000 passengers on ten minute flights and retired from airline service. During this period, "Tommy" took the ship to altitudes of better than 26,000 feet with full loads. On one occasion he purposely flew from Newark to Kansas City without once seeing the ground until he "came through" for his landing.

The first DC-2, which was the DC-1 with a fuselage 20 inches longer and seats for 14 passengers, was delivered to TWA on May 15, 1934. The first DC-2's were pulled by two 710 h.p. Pratt and Whitneys or Wrights. Airline executives started ordering and soon a backlog was built up. The backlog has continued until today, with Pennsylvania-Central Airlines, Delta Airlines and Chicago and Southern the latest customers for DC-3's.

Douglas officials were amazed by the orders. When the first DC-2 went to TWA, one executive said:

"I guess we'd better tool up for 25 ships. That'll take care of everybody for years."

"Make it 50," said an optimist, and was stared down.

However, personnel soon began to understand what Wetzel had meant on returning from Kansas City. He had said:

"Boys, we're going to have to go to town with the new baby."

Traffic on all lines increased steadily. American Airlines came to the company, just as TWA had done, and asked for a sleeper plane.

The DST (Douglas Sleeper Transport) came before the DC-3—merely a night flying version of the later model—because of this demand. Douglas has always said that this ship was more his product than the DC-1 because the company was given freer rein than before.

Special DC-3 version built for TWA is the combination day plane and sleeper above. Below are standard upper and lower berths; passengers prefer them to Pullman berths.

Douglas engineers discovered that they'd have to "barrel" the fuselage to make room for berths. The designers gave them a "mock up." Ten feet were added to the span and the fuselage was lengthened from 62 feet to 64 feet 6 inches. Two 850 h.p. engines were used.

"We want the job early in 1936," American Airlines officials said. The first DST was delivered to that company on April 29 of that year. The DC-3 carried a bigger load. Gross lift jumped from 18,000 pounds to 24,000. Sky lounges with 14 swivel chairs for day-time transcontinental flight were built, first of the DC-3's. Soon this type was discarded when it was found that 21 seats could be put into the fuselage and still give passengers plenty of room. TWA asked for and got the "Sky Club"—a combination job containing both seats and berths.

Experimentation cost considerable, but was small in view of what other experimentation in aviation has amounted to. The first officially designated DC-3 had a charge of $400,000 against it. It was delivered to American Airlines August 18, 1936.

From the delivery of the first DC-2, cruising speed was set at 180 m.p.h. and this figure had never been increased. Horsepower, however, has leaped from the original 710 per motor to 1,050 per motor, with 1,200 for take-off. Present motors use less of their maximum output, give greater reserve for emergency and faster take-off as well as single-engine performance. Safety and comfort have always comes ahead of speed in designing and building the DC's.

The DC-3 has risen to a position of world dominance simply because no other nation has been able to build such a ship, or anything comparing with it, for the same price. While many Douglases have been sold to foreign airlines and form a bulk of the international aerial network, manufacturers have stayed out

(*Continued on page 72*)

HEADS UP, SOLDIER!

by

MAJOR ROLAND BIRNN

★

Attack aviation in the Army Air Corps is no more. Instead, the light bomber is expected to deal death more efficiently

WITH the advent of 1940 the War Department released the news of the designation of new squadrons and groups being formed in the expanding Army Air Corps. Conspicuous for their absence were those squadrons bearing the not-so-ancient but quite honorable name of "attack". Instead, a new type of unit came into prominence, if you happened to be watching for that sort of stuff; the light bombardment squadron and the groups of such squadrons. Already those civilians living near Barksdale Field in Louisiana must have noticed the recent switching from "attack" to "bombardment (light)" as far as it concerned the 3rd Group and its squadrons at that field. Planes flying from there no longer bore the letters "AC" (Attack, 3rd Group) on their vertical fins; these letters have been changed to "BC".

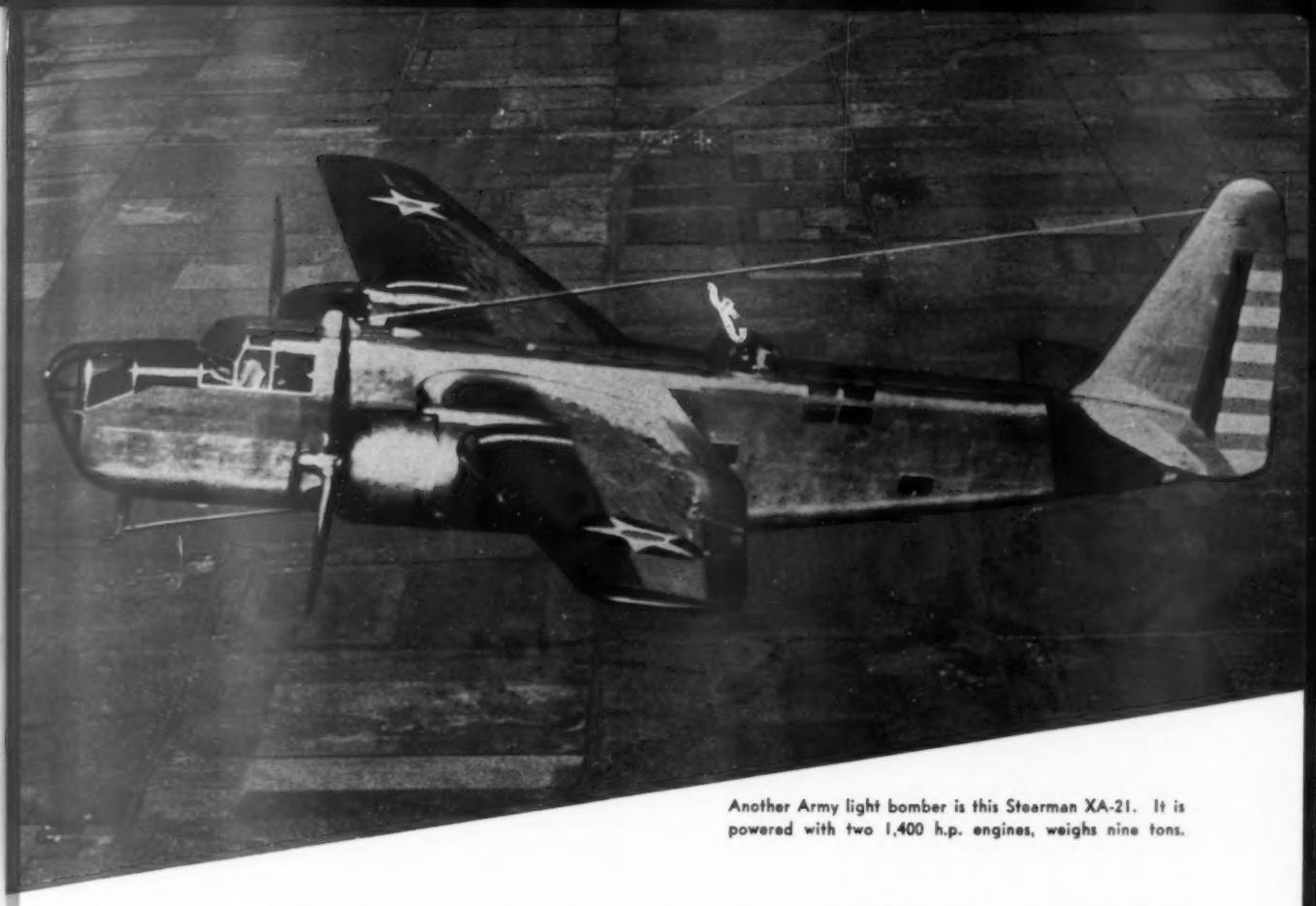
"What's happened?" a number of people have asked. "Have they done away with attack aviation entirely? Don't they believe in it any more? Is it because of lessons learned during the Spanish trouble or World War No. II? Did they find out that you can't mow down troops on the march or afield from low flying airplanes?" And a very few well informed inquirers have mentioned that such a change appeared strange when British service journals contained articles on the need for a British equivalent for what the Yankees called "attack".

If you try to answer these questions with words alone the result is quite as confusing as the barrage of questions. So you grab yourself a pencil and paper and, without betraying any secrets or hot data on exact relative efficiency of weapons and the men firing them, you can make it quite clear that troops and light objectives may still be attacked by our low flying airplanes, if that happens to be the best way to attack them—or by *higher* flying airplanes, if *that* happens to be best. Also that for the employment of this type of aviation you might well use an airplane that can not only attack personnel *and* light objectives but can also perform certain bombardment missions against objectives only, and do the latter job better than if the medium type of bombardment airplane were employed.

In other words the Army has *not* abandoned the *idea* of attacking personnel and light objectives from the air. Rather, it has abandoned any set idea it may have had that such objectives *must* be attacked by low-flying, hedge-hopping, aircraft and substituted the idea that, considering all the factors involved, it may be better to attack from 300 feet, 3,000 feet or even 8,000 feet altitude, whichever altitude is best suited for the occasion. The Army also believes that it is getting airplanes which will do the trick reasonably well at any low or intermediate altitude.

It is extremely doubtful if the employment of ground-straffing planes in the comparatively recent Spanish fracas showed American flyers what they didn't know before. The few press reports which gave details invariably mentioned the attackers coming in at only a *fairly* low altitude, but seldom mentioned any tree-scraping. Reports often described these assaults as a succession of dives, zooms, circles and more dives at the tar-

This French Martin 167F, now at the front, is almost identical to light bomber ordered by the Army Air Corps.



Another Army light bomber is this Stearman XA-21. It is powered with two 1,400 h.p. engines, weighs nine tons.

gets. Such technique many military flyers believe to be faulty. It denotes a lack of one or more of the following:

Previous information as to the nature of the target and its location,

Faith in the value of the surprise element in a real low-flying attack,

Proper weapons, or type of airplanes with good visibility ahead and below.

One cannot place much blame on the pilots themselves for this faulty technique. However, it does take more guts to jump a column of troops or possibly a defended airdrome at an extremely low altitude and go tearing down the column or across the airdrome area, than it does to pounce once and pounce again wherever there is disorganization on the ground but avoid those places where the troops are trading you shot for shot or it looks as if a stiff resistance were being made Not that a very low-flying attack is any more dangerous than the series of dives, but any pilot can tell you that there's just something about this dive, circle and dive stuff that makes you feel that you have the upper hand.

There is a situation that is often called the "attack pilot's dream." That is where troops are marching eight abreast down a straight road with the sun in their eyes, with a medium sized hill screening the approach of the pilot's attack plane. The road is in a deep cut or between two lakes, making it impossible for the troops to tumble off the road to comparative safety. There's another dream for the air force commander and his production staff—an all-purpose airplane. That dream can never come true in whole, but much effort is always being made to partially realize its benefits. Undoubtedly the many reports of bombing raids by small numbers of airplanes in the current European struggle indicate that most of these "raids" were nothing more than reconnaissance flights; further indicating that bombing planes were also being used for reconnaissance missions. Residents of Miami may have

THE ATTACK PLANE AT WORK

Advantage.	Disadvantage.
Above effective rifle and small caliber automatic weapon fire.	
Can use bomb sight.	Within effective large caliber anti-aircraft gun fire.
Need not use specially fused or constructed bomb.	Cannot spray chemicals effectively.
Can sight enemy target some distance ahead and be prepared for assault.	Surprise effect totally lost.
	May be effectively attacked by enemy pursuit aviation.
Above effective rifle fire but within effective range of small caliber automatic weapons.	
Need not use specially fused or constructed bombs.	Can hardly use bomb sight but too high for good bombing without it.
Too low for large caliber antiaircraft gun fire.	Surprise effect materially lessened.
Too low for effective attacks by enemy pursuit aviation.	A long time within field of fire of small caliber automatic weapons.
Safe for night attacks or when visibility is poor.	
Right over the tree tops or the waves.	
Cannot be effectively attacked by enemy pursuit aviation.	Night attacks dangerous; same when visibility is poor.
Surprise effect through concealed approach.	Within effective range of *all* small caliber gun fire.
Get grazing fire from forward guns.	Burst on to target without much time for preparation.
Chemicals can be effectively sprayed.	Must use specially constructed or fused bombs.

Air Corps engineers are replacing attack planes with attack bombers like this North American NA-50. Its engines are two 1,500 h.p. "Cyclones". Top speed is 295 m.p.h., range 1,462 miles, ceiling 32,000 ft.

noticed that the 21st Reconnaissance Squadron recently stationed there for temporary duty has been using B-18A bombers for reconnaissance missions.

Other combinations have been employed in the past, as in the old gull-winged O-35—B-7 combination. Some combinations have not been successful, as in the case of corps observation airplanes being used for ground-strafing missions, usually over the protests of the observation aviation people. The observation airplane was built around the observer and the gadgets he handled. The attack airplane was built around the hardware destined to be thrown at personnel and light materiel objectives on the ground. Also the combat crews were trained differently—and here we have a factor which is just as important as specialized equipment. The combat crew of the observation airplane is trained to appreciate the military scene below, to report what it considers worth reporting and to evade air combat if at all possible. The pilot and gunner of an attack airplane are trained in the means and methods of destruction of personnel and light material objectives on the ground by thingamabobs dropped or shot from their airplane. They are also trained to expect resistance from their targets—when these are humans—and to go in and attack regardless of such resistance. To be sure, there are some differences in technique between hedge-hopping attacks and those from intermediate altitudes, but these differences are not so great if the combat crew uses the same type of airplane for the belly-scraping assault as it does for those from a little higher altitude.

There are two main advantages in having a dual-purpose military airplane. The first is that of production, both quantity and cost and in ease of supply and maintenance of large numbers of just one type of airplane. Another is that of employment, when once the mission has been planned or the formation has taken off and it becomes necessary at the last moment to cope with a sudden change in the situation and perhaps change the type of bomb to be used or the altitude to be flown or to make similar changes. It takes no master mind to see that a dual purpose craft cannot be as efficient as each of the specialized types it displaces. There are certain duplications or degrees of duplication where the advantages are overbalanced by the disadvantages and a short sighted and pinch-penny policy of carrying the all-purpose idea too far will result only in lots of standardization but no efficiency in tactical employment.

Before we go any further on tactical employment, it should be clearly understood that troops on the march will probably *not* be the universal target of light bombardment aviation. Pictorially such a type of mission is most spectacular, but in the Polish campaign (remember it, 'way back in 1939?) ground-strafing German aircraft concentrated first on the airdromes of the Polish Air Force. All the troop targets on which the German Air Force may have been concentrated later did not approximate in importance these counter air force operations against airdromes and aircraft on the ground.

Many airmen feel that there should be no middle course as far as altitude of attack on personnel and light materiel objectives is concerned; that the airplanes should either come in just over the tree tops or else well above the effective range of small arms and small caliber automatic weapon fire. The air commander is very fortunate when he is up against a situation where a certain altitude is conclusively the best one. It is the opinion of the author that *most* often the group or squadron or flight commander must decide which altitude is "least worst".

A formation coming in and skimming the contours cannot be effectively attacked by hostile pursuit aviation. The latter cannot maneuver to get through the blind angle of the light bombardment gunfire and it cannot even deliver a good following attack because the pursuit pilot cannot fly as low as the man he is chasing and still sight his guns. The pursuiter may deliver a diving attack from the rear, but he must have a marked superiority in speed to zoom up and dive again and again. Few if any types of pursuit aircraft are designed for good performance at sea level. Also, before attacking the low-flying light bombardment formation, the pursuit must first spot it from the air—a difficult thing in itself. The chief advantage of a very low altitude assault is that of surprise, when advantage is taken of trees and hills to cover the approach on the target and get in the licks before the defenders on the ground can unlimber their guns. In general, the larger the gun the longer time it will take to get it into effective action. Not only that, but the time-fused shells of the larger caliber anti-aircraft guns cannot be set to function at a low altitude nor can the muzzle of the large guns be tracked across the sky as fast as the hedge-hoppers can fly across. The effect of grazing fire from very low flying airplanes is problematical, although doughboys attach great importance to grazing fire from machine guns on the ground firing across level terrain at advancing troops. To say the least, however, it must be extremely annoying and even destructive of morale to the defender on the ground to hear and feel aerial machine gun bullets striking all around and even through him before he sees or hears the planes from whence they come.

All is not gravy in a low-flying assault. Specially constructed or time-fused bombs must be used so that fragments therefrom will not pierce the

(*Continued on page* 97)

On order for the Army Air Corps is a large number of Douglas twin-engined, tricycle-geared attack bombers. They resemble DB-7's now being delivered to French air force.

Book Bug

by WILLIAM STARK

Nothing fascinates Ernest Robischon like a book on aviation. He probably has the largest private aeronautical library in the land.

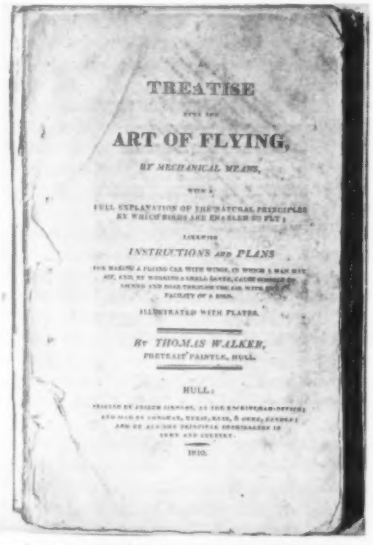
Ernest Robischon

HOW would you like to leaf through the pages of a handbook, published in 1810, giving complete instructions for the building of a flying machine and how to fly it? Or perhaps you're more practical and would rather study the working drawings from which the Wright brothers built their first airplane . . . a design for a full cantilever wing drawn in 1911 . . . the retractable landing gear incorporated in the French Penaud-Gauchot amphibian of 1876?

All these curios of aviation science—and thousands more—are to be found in Ernest Robischon's aeronautical library, one of the most complete privately-owned collections of aviation research material in the United States.

Three years after the World War a couple of ex-Army pilots in search of a bathroom unwittingly laid the foundation for the library, in this manner:

The former Army pilots set themselves up as flight operators on a makeshift field in North Caldwell, N. J. Living quarters were included—but these had no bathing facilities. The neighborly Robischon family across the road came to the rescue and the pilots bathed regularly, showing their gratitude by taking ten-year-old Ernest and his brother for hops in their Standards and Jennies. Later came evenings in the Robischon living room when the aviators, accepted into the family circle, sipped tall glasses of beer and yarned of men and airplanes over the Western Front while Ernest listened wide-eyed. These evenings innoculated the boy forever with the virus of aeronautical enthusiasm.



TREATISE

ART OF FLYING,

BY MECHANICAL MEANS,

INSTRUCTIONS AND PLANS

ILLUSTRATED WITH PLATES.

By THOMAS WALKER,

HULL:

1810.

Among prized volumes in the Robischon library is this treatise written in 1810.

Today in his California home Ernest Robischon has more than a thousand books, between 4 and 5,000 magazines (including complete files of several long since suspended), newspaper special editions, yellowed early-day photographs, three-view drawings of airplanes, accurate models and detailed paintings of the first machines that flew.

Robischon journeyed to California in 1934 to attend an aeronautical engineering school. A classmate one day handed him a dog-eared little book "The Aeroplane Speaks," published in 1917. The fellow student had paid ten cents for it in a second-hand store, merely as a curio.

"That little gift has cost me thousands of dollars," says Robischon with a smile. "It was a peephole into the past of aviation. It was less than two decades off the press and yet it was old. I thought that there must be older and even more interesting books existing and started, casually at first, to look for them."

The next thing he knew Robischon had abandoned his mechanical studies for his new, more absorbing avocation. His library grew first out of curiosity, then as a hobby, and now is a serious endeavor that is assuming the stature of a career. Some of his most precious exhibits are odd items like the 1810 handbook but most are organized groups of valuable research material.

A sample, for instance, is the complete set of references to which Wilbur and Orville Wright turned when they first sought to study and apply the principles of heavier-than-air flight. Robischon acquired several Wright brothers' biographies and from them compiled a list of the books the famous brothers studied as youths, the references they used in building their first plane. Then he set about finding—with complete success—the long out-of-print volumes.

Here is the present force behind Robischon's efforts:

"I am no longer interested merely in collecting aviation books," he explains. "What I'm engaged in now is a serious attempt to document man's struggle to fly. I believe with Juan de la Cierva that in the evolution of human flight, man somewhere reached a crossroad where he took the fork leading to development of our present form of airplane. In his studies de la Cierva went back to the crossroad and found another turning—the one leading to rotating wing aircraft. Maybe there is still another path to be followed—one that will lead us to solutions of many of our most puzzling problems. Proper documentation may reveal that path. . . ."

Robischon underlines his belief by pulling from his shelves book after book showing that many of our "modern" achievements were born decades ago. They failed, he believes, only because the world then lacked the materials and processes it has now. He will show you the already mentioned cantilever wing and retractable landing gear, the radial engine on the Langley plane of 1901, a full description of the use of flaps for slower landing speeds and shorter takeoffs, published in London in 1917. Neither the wing slot nor the automatic controllable pitch propeller is a new conception—both were incorporated in fairly workable designs drawn long before some of our present day aircraft builders were born.

The Robischon library contains whole shelves of American and British publications, plus row on row of German, French, Russian, Japanese, Chinese, Dutch and Italian books, technical journals, aeronautical magazines and yearbooks. Many of these are of modern

(*Continued on page 68*)

Douhet advocated widespread bombardment of cities to break down morale. Above: Shanghai after Jap air raid.

DOCTRINE OF RUTHLESSNESS

by THOMAS MAHONEY

The much-feared aerial "blitzkreig" first was conceived and described by an Italian general named Douhet. This is his story.

SHADOWS of Napoleon, Clausewitz and other long-dead strategists fall across the military council tables today, but the heaviest shadow of all is that of General Giulio Douhet, a little-known Italian officer who spent a year of the World War in one of his country's prisons. He died in 1930, but the doctrine of air war to which he gave his name today is a matter of life or death for Europeans.

The Douhet doctrine is a set of principles for waging war in a ruthless and desperate manner. The salient points are:

1. A nation's air force should be as strong as possible and a separate arm.
2. A single trained commander for army, navy and air forces.
3. In war, a secondary or defensive role for the army and navy with the offensive entrusted to the air force.
4. This offensive to be terrorizing bombing attacks on the enemy's vital centers and civilian population to break his "will to war."

Douhet summed up with *"Resistere sulla superficie, per par massa nell'aria*—To adopt a defensive attitude on the surface and to mass for an offensive in the air." He wrote: "To gain the mastery of the air is to conquer; to be beaten in the air is to be conquered and obliged to accept any terms that the enemy desires to impose."

Though his doctrine has yet to stand the test of a major war and is questioned by many, Douhet's works present it so persuasively that his name is regarded by the advocates of air power with the veneration which proponents of sea power have for Mahan, the American Naval writer. The career and exact ideas of the Italian, however, are little known.

General Giulio Douhet

Douhet was born in 1869 at Caserta, in southern Italy. He elected at soldier's career and emerged from the military academy as a lieutenant of artillery. He later studied electrical engineering at the Turin Institute of Technology and won honors with a paper on electric motors. When the automobile appeared, Douhet recognized its possibilities for war and in 1900 wrote a book titled "Heavy and Military Locomotion."

It was natural that a man with this scientific background should appreciate the airplane. In 1909, while most of the world was still scoffing at heavier-than-air machines, Douhet wrote: "Now we are fully conscious of the mastery of the sea. Soon it will be no less important to gain the mastery of the air. It will be fought for."

In 1911, Douhet became commander of Italy's first flight battalion at Turin, organized the first Italian flying school and set up the first shop in the country for airplane construction. This was started in a shed with Giovanni Caproni, later famous as a builder of mighty bombers, among the workmen.

"The arm of space will be sovereign," he declared in a 1913 lecture. "A new arm is born, the arm of the air. A new field of battle has opened, the sky. A new fact has presented itself in the history of war, the birth of a principle of warfare."

He wanted Italy to join the Allies in 1914 and wrote articles for the *Gazetta del Populo* urging this. When Italy entered the struggle he was sent to the front, not as an aviation officer, but as chief of staff of the Milanese division. His superiors seemed incredibly stupid to Douhet. At first he contented himself with writing his opinions and, in the presence of witnesses, daily sealing the papers. These notes were published in 1921 under the title, "A Critical War Diary."

In 1916, Douhet felt it his duty to send a memorandum on the dangerous condition of the Italian front to Leonida Bissolati, a member of the cabinet. The Italians had captured Gorizia but, in Douhet's words, had only a frontal deployment of troops with no "profundity or zones of resistance at their rear." A police cordon had been spread out along the front instead of an army.

This memorandum was intercepted and reached General Luigi Cadorna, the Italian commander. He was outraged at Douhet's flouting of regulations by failing to send his communication through military routine and also at the criticism. Cadorna termed it "calumnious." Douhet was court-mar-

Devastating aerial bombardment by Japanese airmen left many Chinese cities in burning ruins like these.

tialed and sentenced to a year in the Piedmont prison fortress at Fenestrelle.

Disaster came to Italy just as Douhet completed his sentence. Six German divisions crashed through at Caporetto in just such an attack as Douhet had forecast. In three days, 200,000 men and 1,800 guns were lost. By the time the rout was stopped the Italians had lost 800,000 men through death, capture and desertion. The accuracy of his prophecy made Douhet a popular hero. He was recalled to service as chief of the central division of aviation. Before the Armistice, he published a short novel titled, "The End of the Great War, or Winged Victory," in which he cast two protagonists, an Allied air force large enough to control the air and an Austrian ace who, facing massed action, represented the futile heroism of the individual.

Douhet resigned from the army at the end of the war, ran unsuccessfully for the Italian parliament and founded a magazine, *Il Dovere* (The Dove). In this he made the first suggestion that Italy honor an unknown soldier. Douhet became an ardent Fascist and carried Mussolini's greetings to D'Annunzio, besieged in Fiume.

In 1920, the High Tribunal of War and Navy canceled the 1916 judgment, ruling that Douhet had "sacrificed his personal interest and the bonds of discipline for the good of his country." In 1921, he was made a general and the first edition of his most famous book, "The Mastery of the Air" was published. The volume is a masterly argument for the airplane as a weapon.

"Independent of the ground and more rapid than any other medium of action, the air force is the offensive arm par excellence," Douhet wrote. "It can go from one point to another not only by the shortest road in a straight line, but also by a great number of other roads. There is no practical way of avoiding attack by enemy air forces save by destroying those forces. The nation which adopts the offensive has the advantage of choosing the objective and of being able to concentrate all its forces at the point of attack. The adversary must disperse his forces and wait this attack. For defense, an air force greater than that of the attacker is required near each center to be defended—for 20 centers an air force 20 times that of the attacker. The airplane is not suited for defensive action."

Bomb dropping is the proper role of airplanes in war, asserted Douhet. He favored gas and germ bombs if effective ones could be made. He wrote: "Not only explosive, but also chemical and bacteriological poisons can be carried by the aerial arm to any point of the enemy's territory, scattering death and destruction over the entire country." The moral effect, he believed, would be far greater than the material damage. This was his big idea.

"What could an army do with its lines of communication cut, its stores set on fire, its centers of provision and refitment destroyed?" he asked. "What could a fleet do, supposing its ports were no longer safe, its bases burned and its arsenals and freighters destroyed?"

Let us suppose that in a few minutes a city receives in its central part within a radius of about 250 meters (820 feet), 20 tons of bombs. Explosions are followed by fires. Gases that kill prevent approach to the zone which has been bombed. Then fires develop and spread. The poisonous gases persist. The hours pass, and finally daylight comes, while the poison spreads and permeates the air. Traffic on the main routes, if they come through the city, will be suspended. Traffic on the railroad, if the station is affected, will be stopped. Life itself will be stopped. What happens in one town can, on the same day, happen in 10, 20 or 50 great centers and, with the news spreading, other centers will feel the menace. What government will be strong enough to maintain order? How can industry be made to function regularly? And even if an appearance of order remains, even if some work can be done, will not the mere sight of a single airplane be enough to produce serious panics? If, on the second day, 10, 20 or 50 other cities are hit, who will be able to prevent the distracted population from scattering over the countryside? Necessarily, a complete dissolution of the national governmental structure will take place. It will not be

(*Continued on page* 82)

FIRES CAN BE PREVENTED

by

JEROME LEDERER

This ship caught fire in the air, the pilot landed safely but the airplane was a total washout.

The author, a prominent aviation insurance engineer, offers some invaluable pointers to aircraft owners and operators. A "must" for flyers.

FIRE probably is the most terrible and the most feared of the perils that endanger aircraft and airmen. Fire losses annually are great. Often they attend fatalities because fires so frequently follow crashes. It is proper and wise that these risks be faced squarely, their causes studied and precautions taken to minimize them.

The Aero Insurance Underwriters, like other aviation underwriters and insurance agencies, have made a study of air safety—particularly relating to fire and fire hazards. Herewith I intend to give my readers some of the practical results of our studies and recount for them some of the details of accidents that involve fires in aircraft—some occurring in flight and others on the ground.

Within the last year the newspapers have carried accounts of several accidents in which fire in the air occurred aboard large passenger-carrying airplanes. In one case the fuel line on the left engine of a twin-motored type—DC-3—broke in flight. The engine kept on running but fire developed under the cowling. The pilot couldn't see what had happened because of that cowling. The fire was like the blaze in a blow-torch, because it was in the propeller-blast through the engine nacelle. It was small and hot but hardly visible. The fuel pressure kept falling and the head temperature rose so the pilot knew something was wrong. He landed his airplane safely, but as soon as the plane lost speed the air blast no longer confined the blaze. It spread so rapidly that passengers had time merely to get out of the plane, leaving behind them baggage, cloaks and all their belongings. In that case the pilots and the rest of the crew were declared heroes.

In another recent instance a pilot became conscious of fire while flying at 3,000 feet. His nose informed him that insulation was burning. So he turned off the generator and the master switch that led from the battery to all the electrical apparatus. As he began losing altitude preparatory to a forced landing one of the passengers in the ship—this time a small cabin model—said that the rear of the seat on which he was leaning was becoming hot.

The passenger removed the cushion and found the upholstery smoldering. This was extinguished. When the passengers raised the lid under the seat cushion that gave access to the radio receiver and battery, large flames leaped into their faces. The pilot had an extinguisher but decided against using it, feeling that the combination of flame and extinguisher fumes might knock him out. The passengers closed the lid, replaced the seat cushions and sat down

Backfires always should be anticipated. One set this ship afire and wrecked it.

on them to keep the fire within the radio compartment. The pilot then made a safe landing and all aboard escaped—but the airplane was totally destroyed.

Carburetor backfires are frequent causes of airplane fires. Backfires result from flame in the cylinder shooting out of the inlet port and down into the carburetor. Improper or slow burning of fuel inside the cylinder—either from a too-rich mixture or from too lean a mixture—usually causes this. If such a fire occurs in the air it can usually be extinguished by opening the throttle wide and sucking the flames into the engine. This is also true of backfires that occur on the ground. The approved procedure is to turn off the gasoline, open the throttle fully and, if in the air, lose height by side-slipping away from the flames. The ignition switch should be shut off after the engine runs the fuel lines dry and quits firing.

Most frequently carburetor fires on the ground are caused by attempting to start a cold engine where the gasoline in the overprimed cylinder continues to burn while the inlet valve is still open, allowing the flame to shoot back into the carburetor. Or it might be the result of a crack in the inlet manifold which leans out the mixture.

In winter, experience has shown, it is most desirable to start engines with the tail of the ship into the wind so that if a fire does occur in the carburetor there will be less tendency for the flames to lick backward along the fuselage and ignite the fabric. Once an engine is started and running smoothly, however, it is wise to point the nose into the wind because this aids in cooling and in preventing overheating.

Pilots tend to forget even obvious precautions that must be taken. For instance, ships have been lost because engines were started while the plane was standing in high dead grass. Hot carbon particles dropped from the exhaust ignited the grass, which in turn caused the total loss of the plane. Similarly there have been airplane fire losses from starting an engine over a pool of gasoline that had dripped from its carburetor to the ground.

Chances for fire in an airplane, on the ground or in the air, can be materially lessened by periodically checking the fuel system, tanks, pipes and fittings for leaks, cracks or worn hose connections. The fuel and oil systems should be checked under pressure if a pressure system is used. It also is important to see that the wing compartments holding the fuel tanks be well ventilated and drained if there is the slightest danger of gasoline getting into them during refueling or by other means. If the tank is in the fuselage the same precaution should be taken. Gas fumes in these confined spaces can be ignited by a spark caused by a bad electrical connection, by movement of metal parts such as control cables, by radio sparks and by loose bonding connections.

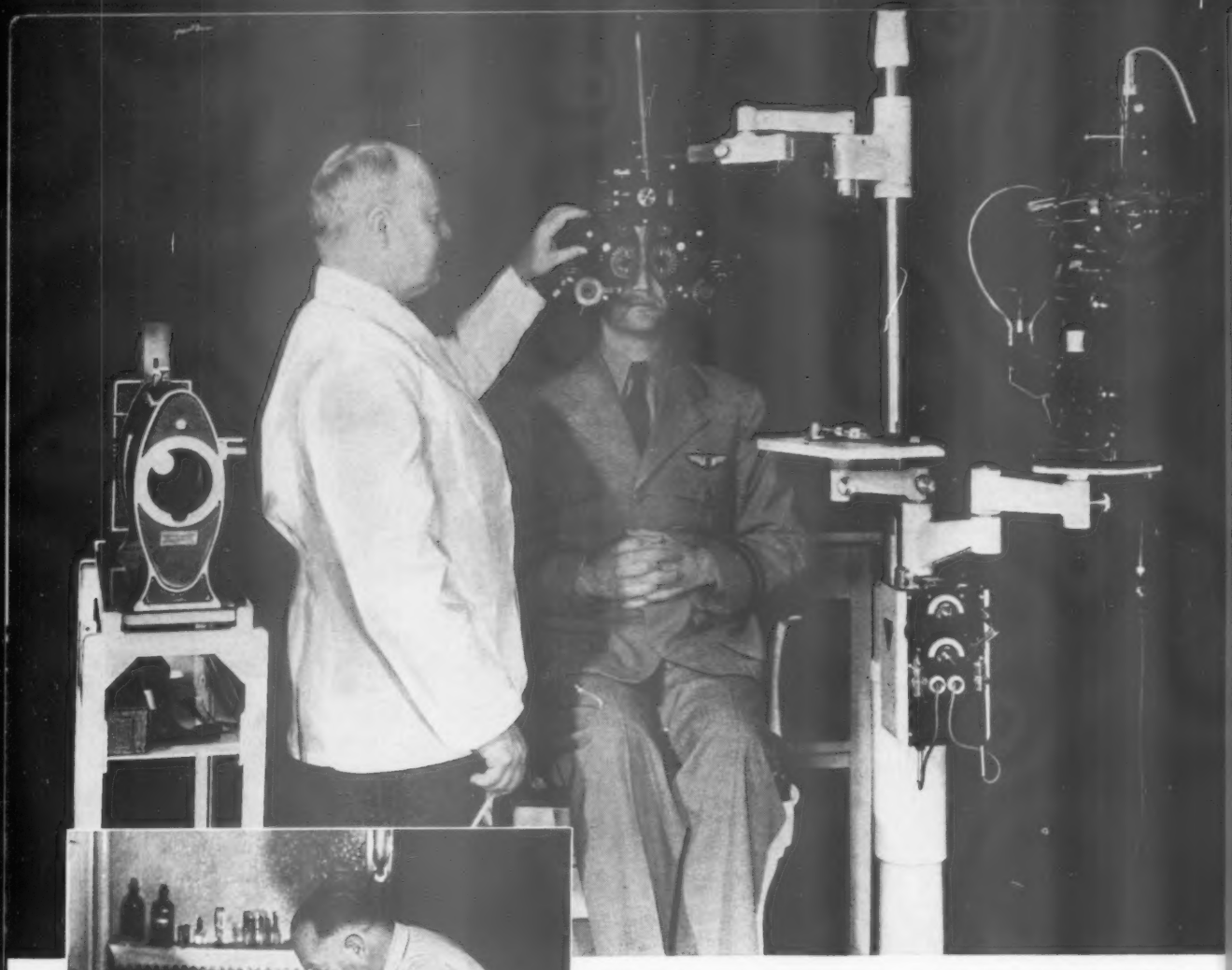
All drain plugs in the fuel and oil systems should be frequently checked. The following story illustrates the need for this: a tired mechanic was safetying the drain plug on an oil tank in a single-engined fabric-covered airmail plane. The drain plug had been drilled through the head so that a safety wire could be run through the hole. On either side of the plug a brass stud projected from the cowling, each one drilled to receive the safety wire. The mechanic threaded the wire through one stud, thought he had the wire through the plug, then threaded the end through the other stud. He then completed the job, as he thought, of safetying the plug by braiding the wire. He was tired and failed to realize he had missed the hole in the plug.

The ship was taken into the air, flew satisfactorily for a while, but the constant vibration loosened the plug. Finally it dropped out, allowing the oil to run back from the bottom of the cowling to the fabric on the under side of the ship. There it caught fire from the heat of the exhaust pipes. The pilot saved himself by jumping, but the ship was lost.

Static electricity is a frequent cause of fire in servicing planes. It can be created by the passage of gasoline through a hose. The hose absorbs the charge, which then seeks to escape through the hose nozzle when the nozzle is brought in contact with a good conductor. If that conductor happens to be the filler neck of a gasoline tank with the correct mixture of air and vapor in its vicinity, the spark will set off an explosion and fire will usually follow. This is the reason for the care shown by most operators in grounding the nozzle to the tank or some other metal part of the ship

(*Continued on page* 80)

Sudden fire in the air brought this ship down without injury to the pilots. Chances for fires can be lessened by carefully checking fuel system, tanks, pipes and hose.



The pilot's eyes must be near-perfect and are rigidly checked periodically.

Ears, nose and throat are watched carefully for infection.

FLIGHT SURGEON

by

STEPHEN BATES

Aviation medicine is a highly specialized field. Flying has its own peculiar requirements.

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THERE is an old tradition that the Chinese pay their doctors to keep them well. The operators of America's commercial airlines must agree that this is pretty smart, because today hardly a single company is without its corps of especially-trained flight surgeons whose job is fundamentally to keep pilots and ground employees physically and psychologically fit and only secondarily to do any patching up.

These specialists are among the lesser-known cogs in the vast national air transport machine, yet they are among the most important. It is they who decide who is going to be an airline pilot in the first place, who say how long he keeps his job and who read him off the active list the minute that his arduous occupation starts to "get" him. On every commercial field their word is law and the consequences of disobedience are apt to be so terrible that the punishment usually is immediate dismissal.

The flight surgeon's most important task is to *prevent* anything from going wrong with the pilot, just as the maintenance superintendent's biggest task is to *prevent* anything from going wrong with the motors. Flying nowadays is so safe that there are only two types of men unfit to pilot a plane, those with serious physical defects and those whose nervous system is fatigued. However, the determination of what constitutes a physical condition serious enough to ground a pilot is a job that requires special training, since minor defects that pass unnoticed on the ground are likely to be intensified in the air. The decision as to whether or not a pilot is too tired to fly is another tricky matter, inasmuch as a man who is 15 per cent under par can be far more dangerous than one who is really sick: the really sick man will usually report his condition and seek treatment, while the one who is merely tired may hide his weariness and take his flight out on schedule.

In order to do his job scientifically and successfully, the air doctor has had to develop a specialized type of medicine which is only now beginning to gain official recognition, although it got its start back in the days of the World War. The first few weeks of active air operations on the western front were enough to demonstrate the importance of the human element as a cause of accidents. Pilots cracked up every day, either because they lacked the requisite skill and training or because their physical, mental or psychic reactions were inadequate when an emergency arose.

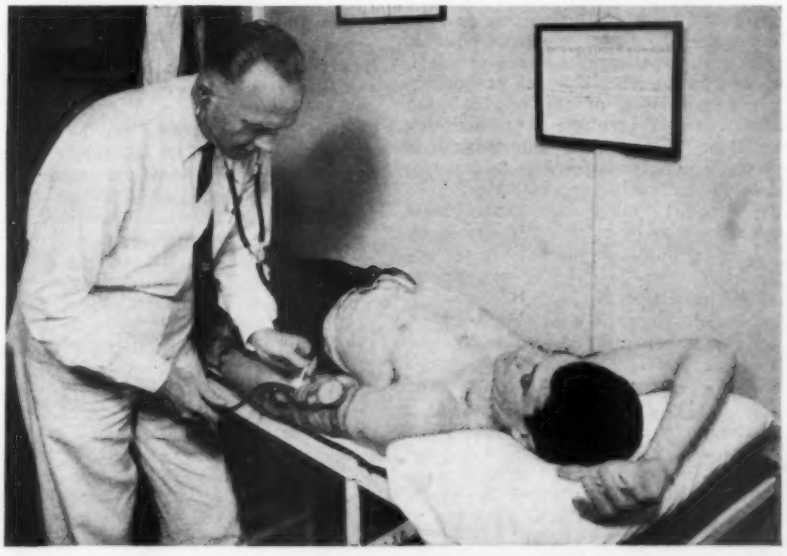
Italy was the only nation to require a special physical examination of airmen at the beginning of the war. Great Britain's flyers suffered many serious crack-ups before a board was named to study their cause and methods of preventing them. The United States gained by the experience of these countries, sending a medical commission to Europe in 1917 to look into the methods they had adopted and to pass on their effectiveness.

The work of that committee brought to both the Army and the Navy an abrupt realization that the ordinary physical examination was inadequate for flying personnel. It led eventually to the adoption of a rigid system of physical selection of prospective flyers, an even more careful supervision and maintenance of the Service-trained aviator, and the establishment of the famous School of Aviation Medicine at Randolph Field.

United Air Lines uses this audiometer in a soundproofed room to test hearing. The pilot must be able to hear sound frequencies ranging from 126 to 11,584 cycles per second.

There is a vast difference between the flimsy crates of World War days and the sturdy, dependable ships of today. On the one hand, the airman's personal physical risk has steadily decreased. On the other, his responsibilities have been multiplied. Many of the medical regulations for flyers adopted in 1917 have

This flight surgeon is taking an airline pilot's reclining blood pressure, the first step in the widely-used Schneider index test. This test gives pilot a numerical rating as to fitness.



In addition to flight surgeons, some airlines maintain a complete medical laboratory. The United Air Lines medical technician above is taking a pilot's blood cell count.

been discarded, some have been revised to cope with new conditions, while a few have retained their original form through the years. But out of all the experimentation an important new specialty has come into being—aviation medicine—and a new specialist has appeared—the flight surgeon.

Aviation medicine has as its foundation a good working knowledge of general medicine and surgery. It covers a vast field and the would-be flight surgeon must have, in addition to this basic knowledge, special training in such diverse subjects as ophthalmology, cardiology, altiture physiology, psychology and psychiatry. A graduate course, lasting from four months to a year, supplies these fundamentals. But a year or two of intensive experience in and about a modern airport must follow, during which the would-be flight surgeon is expected to gain enough of a knowledge of flying to enable him to understand the problems, difficulties and dangers encountered by pilots and to discuss them intelligently. During this time he is required to fly as much as possible with both experienced and novice pilots, because in no other way can he possibly get a true idea of the physical and mental strain involved in present-day aviation. Without such knowledge it is virtually impossible for him to assist in determining the cause of airplane accidents and to make intelligent reports upon them, as he is later required to do.

It is on this preliminary tour of duty that the prospective flight surgeon attunes himself to the ways of aviation personnel. He must prove himself tactful, sympathetic and a good mixer, and must demonstrate iniative, unquestionable integrity and a fine general character. Lack of any one of these qualities is enough to disqualify him from his chosen work. The embryo flight surgeon usually is first put to work making routine tests on applicants for jobs. Every licensed commercial pilot has of course already passed the rigid Civil Aeronautics Authority's examination and every one with a recent employment record has had at least one checkup within the past six months at the hands of a C. A. A. inspector. However, few commercial airlines will employ a pilot, even for substitute or emergency work, without the okay of one of its own physicians.

A few months at this type of apprenticeship—which may also include routine checkups on the health of stewardesses, ground-crew workers and administrative employees—and the new flight surgeon is ready for a permanent assignment. From then on his task is chiefly to maintain the men under his care at top physical and mental efficiency and to relieve from duty those who do not measure up to the standards of the airline.

Every checkup on a pilot in the transport service must show that his vision, hearing and ocular balance are perfect and that he has no throat, nose or sinus afflictions. Ears, especially, must be in good condition because of the increasing importance of radio. Heart and circulatory system also must be in A-1 order and there can be no evidence of tremors or unsteadiness.

Most of these factors can be determined objectively in the laboratory. The working pilot's eyes must test to a visual acuity of 20-20 and on refraction show an error of less than one diopter in any meridian. The eye-muscle balance must be good because unbalance causes the victim to have frequent headaches or, worse still, to see double. Depth perception must be fine enough to allow the subject to adjust the rods in the Howard-Dolman apparatus—a box, open at the top and containing parallel rods one centimeter in diameter, one of which can be manipulated back and forth by cords from distances up to 20 feet—within 25 millimeters of each other. Color vision—necessary in order that signal and navigating lights may be recognized—must be perfect and the field of sight—how far the subject can look to the right or left without turning his head—must be exceptionally wide.

The ears, nose and throat must pass an equally severe examination because any inflammation of the upper respiratory passages or of the middle ear is likely to be aggravated by flying. Teeth must be examined for cavities, as the cold air of high altitudes will quickly light up any dental sepsis. Tonsils and adenoids have to be checked and removed if they show any signs of infection. New injection tests have been devised to bring out any possible disturbances of the vestibular apparatus, supplanting the costly Barany chair, which for many years was used for this purpose.

The heart also gets a special going-over and any disturbance noted in the cardio-vascular system is immediately the subject of further investigation. The discovery of heart trouble is one of the leading causes for the grounding of experienced airmen because even the slightest murmur is intensified by altitude and speed.

Examinations for communicable diseases are of course routine. Strength and endurance tests are sometimes given; these take the form of a simple exercise such as stepping from the floor to a chair five times in 15 seconds with no noticeable exertion. "Snap judgment" of speed and distance is also measured.

Then there are other factors that the flight surgeon can determine only by going aloft with the pilot and watching him handle a ship and still others which must be based upon a knowledge of the pilot's home life, especially of the food he eats and the amount of rest he is able to get. What a pilot eats and drinks, whether he sleeps well or suffers from insomnia and how well he gets along with his "home folks" are of great importance and it is the flight surgeon's duty to counsel with those who are not psychologically or physically "right," and to aid them to get back to normal. Sometimes it is necessary for him to ground them until the dangerous period has passed.

Many airline pilots develop at one time or another an "anxiety" about their work that renders them unfit for service for a time. Usually resulting from the stress of early training or of prolonged service in the air, this condition expresses itself in the form of restlessness, irritability, a tendency to jump at sudden noises and an inability to concentrate. It is the flight surgeon's job to spot this "anxiety state" before it becomes too serious, to trace its cause and to help the pilot overcome it. Since overanxiety is usually a symptom—often the earliest symptom—of fatigue and strain, a brief vacation with long hours of good refreshing sleep is the usual prescription.

The Boeing company was the first commercial airline to employ a flight surgeon as a regular member of its staff. Following the lead of the Army and Navy, it asked permission of the Department of Commerce in June, 1928, to have each of its pilots examined by a

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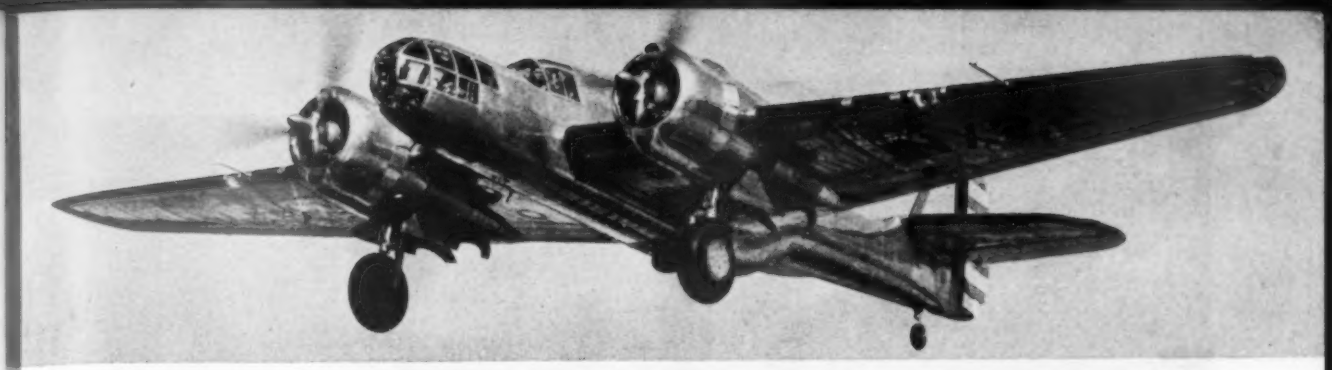
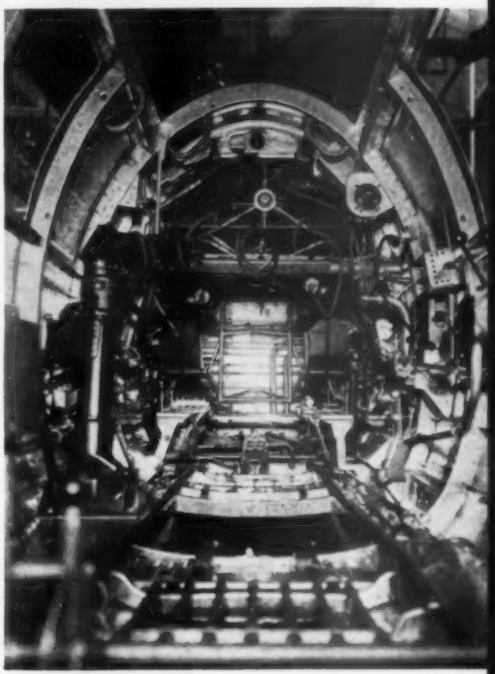


NEXT STOP—THE FRONT

FRENCH bombardment pilots are flying their first batch of Martin 167F's somewhere on the western front as this is written. When the initial French order for these American-built bombers is completed and delivered, the Germans will be faced with one of the deadliest warplanes in the war to date. Designed by James S. McDonnell of Baltimore, the 167F is a modified version of the attack-bomber ordered by the U. S. Army Air Corps. While the Army's model is a military secret, basic figures pertaining to the French version are similar. Top speed with a maximum bomb load of 1,250 lbs. is 274 m.p.h. at sea level; at cruising altitude that figure is 304. Armament consists of four machine guns in the wings and two flexible guns for the rear gunner. The French Martin, shown in various stages of production on this page, is a two-place fighter as well as attack-bomber. At this writing there is no report of the 167F in actual combat.



Visible back through ship's nose are auxiliary controls (foreground) and cockpit.

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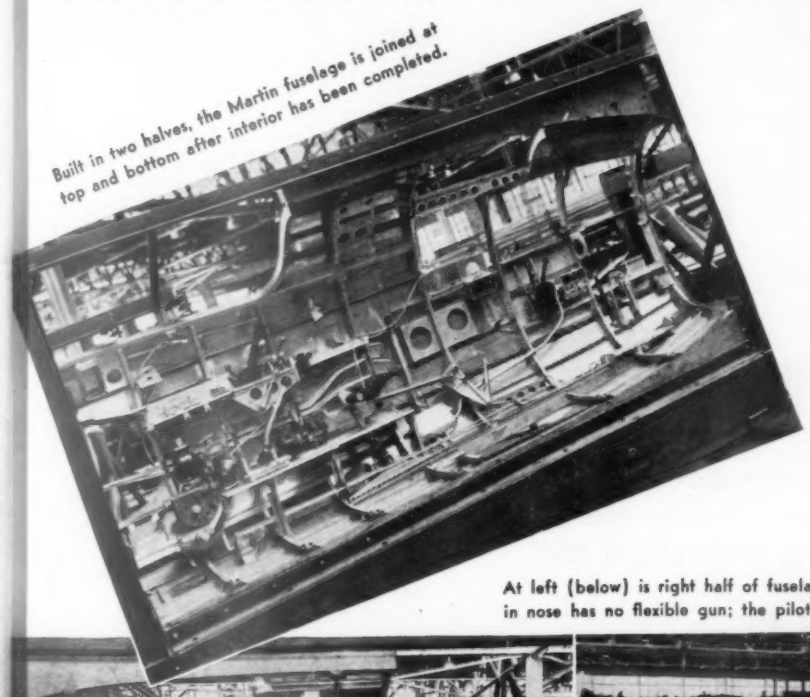
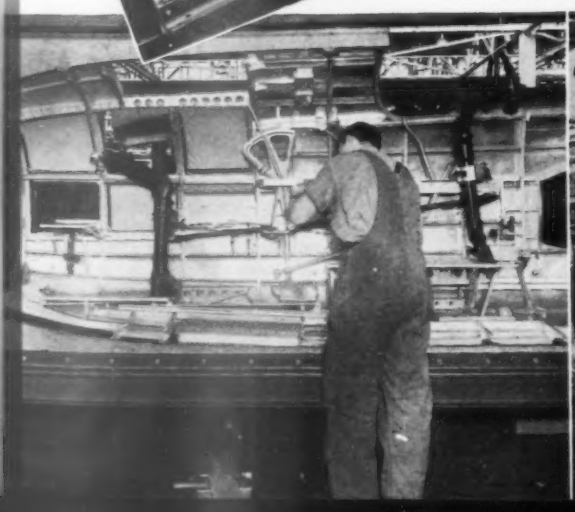


Built in two halves, the Martin fuselage is joined at top and bottom after interior has been completed.

At left (below) is right half of fuselage. Directly below is assembly line. Bomb-aimer in nose has no flexible gun; the pilot fires four guns (two in each wing) from cockpit.



The new Sacramento air base overhauls as many as 120 ships annually at unit costs up to $30,000.

WARBIRD DEPOT

by FRANK CUNNINGHAM

It takes a large and efficient maintenance system to keep military aircraft in the air. Newest overhaul and supply base is worth $7,000,000.

HISTORIC Sacramento, capital of California and site of famous Fort Sutter, citadel in Gold Rush times of the Swiss pioneer Capt. John Sutter, has relegated the stage coach and six-gun days to history books and, during 1939, became as air-minded as plane factory-studded southern California. The past year witnessed the dedication and operation of the new Sacramento Air Depot, the $7,000,000 War Department project that covers 1,200 acres. The base is the most modern of any military depot in the United States and materially helps guarantee the safety of the Pacific and the entire United States.

At this military base, a few miles east of Sacramento, more than $20,000,000 worth of material is received, stored and shipped annually and equipment in excess of $6,000,000 repaired, reconditioned and manufactured.

Long necessary has been a modern depot on the Pacific Coast as a key defense base. Sacramento is one of the four in the nation which handle the supply and maintenance of the military aircraft. The base's territory includes California, Washington, Oregon and Utah and its facilities are so mammoth the depot furnishes supplies for Hawaii, Alaska, the Canal Zone and the Phillipines.

What is this depot which is a model for an air base? How did it come about and what type of flyers are stationed at Sacramento? First let's quote from what Col Harold A. Strauss, the former depot commandant (now stationed in the Canal Zone) said at the dedication:

"Two square miles of rolling pasture land have been transformed into this marvelous depot. The work done here is so impressive that it is difficult to realize the development. This depot has been designed and constructed to embody all the latest equipment and construction features which have been found necessary from a close study of depot operation in the past and to provide for the new and large types of aircraft and equipment which are so rapidly being developed."

Brig.-Gen. George C. Marshall, Chief of Staff of the United States Army, in commenting on the air depot said:

"Common sense on national defense tells us that the public should be told the importance to have the industry geared for the rapid production of planes, for a high standard of production means we have to keep fewer planes on hand. We are fortunate that oceans are on each side of us and good neighbors where there are no oceans. In the last war we were not ready until the end. This time we are getting ready in advance."

Because the writer attended the dedication around April, 1939, and a short time ago returned to survey the operations of the depot, he can realize the immensity of the project It is hard for the eye to take in the gigantic base, the acreage of which is three times as big as Treasure Island of the San Francisco World's Fair. There are three

Of the 800 men employed at the Sacramento base, 450 are mechanics. All types of military aircraft engines can be built here; the base's test block will normally accommodate units up to 3,000 h.p. each.

modern runways, each 5,000 feet long and 150 wide with shoulders of 100 feet on each side, costing a total of $275,000 and which are built so there is always a favorable landing direction. Lights are constructed at each end of the runways so that a pilot will always have floodlights when he needs them, but there will be no glare in his eyes. Numerous smaller lights can fill the entire 1,200 acres with illumination and the houses, buildings and trees are marked with the conventional red warning signals.

The landing field is so large that maintenance on it requires as much work as on nearly 26 miles of ordinary highway and perfect landing conditions will always be on hand despite any weather.

So large are the depot's buildings themselves that there is nothing in the vicinity with which to compare them. The engineering shop covers 13 acres under one roof and is the life-line of the depot. The shops are used for overhauling all types of planes and a complete "going over" costs from $2,000 to $30 000 a craft. The number of ships handled per year can run as high as 1,200. Repair dock hangars have large floor space—200 by 275 feet—and their entrances are 250 feet by 45 feet. At the arch of the hangars an eight story building could be slipped in!

One of the hangars is for the Transport Squadrons based at the depot. Two hangars provide for overhauling and reassembling airplanes as well as tearing down large planes for shipping from the Air Corps' dock located on the Sacramento River.

The writer's guide through the engineering department and repair docks was Maj. Joseph T. Morris, assistant depot engineering officer, who got his college training at Pennsylvania and Yale. In addition to the work on planes and motors, the engineering department also handles the manufacture of many parts for use as replacement units.

Approximately 6,500 tons of steel were used in construction of the building. The docks or hangars are three-hinged arch construction covered by asbestos protected corrugated metal with six reinforced glass skylights in each. Engine shops are structural steel columns and trusses, reinforced concrete walls and covered by wood deck and built-up roof The floors are six-inch reinforced concrete. The cost of the building and its vast amount of machinery ran to nearly $4,000,000.

Eight hundred men are employed in the depot shops. Of these, 450 are mechanics and the ratio of mechanics to clerical help is about 7-1. All are under Civil Service. The Sacramento work is a continuation of the work done at Rockwell Field, former site of the repair shops, but at San Diego only 250 mechanics were employed.

The writer's escorted trip through the shops brought before him the scope of the engineering work. The plant includes the main machine shop and departments for the alignment and repair of fuselages, assembly and cleaning, engine installation and doping and painting. Then there are landing gear and wing section, woodworking shop (where, in addition to plane work, all the benches are made), the electric and battery charging, the radio installation sections, the repair room for starters, generators, spark plugs and all other aircraft electrical equipment.

In the tank section and plating department many different plates can be had, but the main tanks are for cadmium plating as this is both effective and moderate in cost. In the foundry are the heating furnaces for tempering, a machine for making rivets and a hard-

(*Continued on page* 84)

This gigantic hangar covers part of the base's 1,200 acres; the supply building alone covers nine acres.

WPA Airports

Much of this airport at Moline, Ill., was constructed as a WPA project. Notice wide runways.

by EDWARD LAWSON

Many airports throughout the country owe their continued existence to the Works Progress Administration. Herewith the story of its efforts.

WE hovered high above the landing field, waiting for the signal to come down. The Economic Royalist in the seat beside me nudged me in the ribs.

"Look!" he snorted with contempt. "There's another of those WPA signs. Third we've seen this trip!"

"Yeah," I grunted. "Lots of them around the airports, aren't there?"

"Every time I take a plane, they smack me in the eye!" His voice grew bitter. "That one's so big you'd think the WPA boys had built this whole layout. All they really did was throw up those two hangars and lay down some new runways."

I laughed. "That's quite a bit! And if they're doing something for the air industry, why haven't they a right to let folks know about it?"

"Worthwhile!" His face reddened. "Why, that lousy bunch of shovel leaners never yet did anything worthwhile! Loafers, bums, that's what they are, every last one . . . "

I didn't feel like arguing with him then and besides, I didn't know the answers. So I chewed hard on the gum the stewardess had given me. As we settled gently on the runway and prepared to leave the plane, I let my friend rage on. He did, with gusto, even after we were on the ground. Then his limousine drove up and carried him away, leaving me to hail the taxi.

I have never seen him since, but if I ever do, I'll have a lot to tell him. I've checked up on the WPA since then and found that he was nearly 100 per cent wrong. Much maligned and generally laughed at, the Work Projects Administration nevertheless has done as much for the aviation industry in the United States as any other single agency, public or private, and there is hardly a job among all the thousands it has undertaken that can be cited as not worth the time or energy devoted to it.

Believe it or not—and this may depend on whether you vote Democratic or Republican—WPA workers have built about 160 brand new airports since 1934, extended or improved at least 500 others and set up field lighting standards and boundary lights by the thousands. Nearly $150,000,000 has been used for such projects—over half the total spent on American airport development in that time! A lot of money? Certainly. But it's just as certain that the modern transport can't come down in a pasture. It costs real dough to grade and pave an area of several square miles, to set up all the buildings, markers, radio transmitters and other costly gadgets necessary for successful airport operation and to attract air traffic from established bases. Prospective profits are invariably too slim to encourage any great amount of private enterprise.

When the depression came along, the need for larger airports already was apparent. But nothing was done about it and, as years went by and the number of scheduled airlines increased, it became pretty clear that unless the Government helped to develop ground facilities, aviation as a whole would be seriously retarded. So the WPA stepped in—where both fools and angels feared to tread—and did a job in four years that otherwise might have required from 14 to 24.

Today its finished products range from small emergency landing fields, often in heavily wooded and rough country where pastures or other open fields are infrequent, to major air terminals covering several hundred acres in metropolitan centers. Some are seaplane bases, particularly useful in Coast Guard work. Others are "air parks"—emergency landing fields combined with park and recreational areas so as to economize in the maintenance costs that become burdensome to small communities.

The construction of new runways was a particularly important phase of its work. At many airports, aircraft hangars and administration buildings were erected. Some of the new hangars have entrances wide enough to admit transport planes with wingspreads up to 135 feet. In all, nearly 90 per cent of the regular airline stops in the United States have been improved in some way by WPA workers. At the same time, about a quarter of the agency's program has been devoted to modernizing the smaller fields which are the centers of

WPA workers lay all the concrete landing mats and runways on Cleveland airport.

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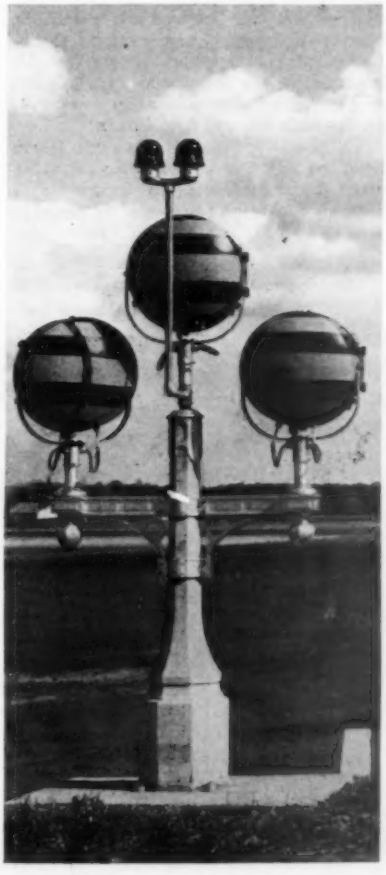
Below is part of field lighting system installed at Harrisburg, Pa., by WPA.



private flying activity and which provide emergency landing space when bad weather forces the big airliners off their course. The improvement of these small airports has undoubtedly been of great benefit to the private flyer and has served to give this phase of the aviation industry a needed bit of promotion.

Every airport touched by WPA's miracle-working shovel leaners is publicly owned and will be available should a national emergency arise. At present many of them are in regular use by National Guard units. Others are providing facilities for the Civil Aeronautics Authority's program of teaching college students to fly. Forty-one of the fields constructed or improved by the WPA are for military use exclusively.

The building of an airport is not too difficult a job, once a good location has been secured. It involves chiefly the clearing and grading of the land, the laying out and paving of runways and the construction of a few buildings of moderate size. A plentiful supply of unskilled labor is one of the biggest requirements and that possibly is the chief reason why the WPA went into airport work so heavily. It had the unskilled labor—hundreds of thousands of men who could handle a shovel, a pick or an asphalt rake but who possessed no trade or technical training. A survey made by the Civil Aeronautics Authority showed that the development of ground facilities for air transportation had not kept pace in recent years with the technical advances in aviation, the increase in air traffic and the use of larger and faster planes. So the two agencies got together and decided to reduce the lag as much as possible before it got too serious.

The WPA crews encountered every imaginable type of obstacle in carrying out the program, but never once defaulted on the job. They built the Barre-Montpelier airport in Vermont on a base of solid granite. They created an emergency landing field at Moshannon, Pa., by cutting the top off a mountain peak and spreading it enough to construct two runways. They leveled off Hartford, Conn.'s field behind a dike 1,100 feet long, thrown up by Army engineers.

To build New York's tremendous new LaGuardia Airport they transported 14,000,000 cubic yards of fill across Long Island Sound by means of trucks which traveled across a temporary bridge span at the rate of one every nine seconds. They increased a landing surface, originally only 100 acres in area, five times by extending it into Flushing Bay. They built four asphalt runways for landplanes, a vast seaplane basin for clipper ships, two administration buildings and seven hangars. Constructed under a constant fire of criticism, in adverse weather part of the time, with some actual sabotaging and always under the lash of necessity to get it finished in a hurry, this mammoth field already has been adjudged by the pilots or American Airlines, United Air Lines and Transcontinental and Western Air—who use it daily—as one of the safest in the United States. These pilots, after a series of test flights, said that the runways, approaches and other topographical details of the airport were more than 90 per cent to their liking. The few defects they pointed out have already been corrected.

Conceived in 1935, when the Post Office Department declined to accept Floyd Bennett Field in Brooklyn as the airmail terminus for the city, its construction was begun in September, 1937, and rushed to completion in a little over two years at a cost of slightly more than $40,000,000. It thus became the WPA's

This WPA pile driver is sinking protecting piles at the Newark, N. J., airport.

biggest single, most outstanding project.

The field has four asphalt runways for landplanes—one of them 5,000 feet in length—and a vast seaplane basin for clipper ships. Two administration buildings and seven hangars, embodying the very latest ideas in airport architecture, are included among the ground facilities. Each runway has available floodlights up to 7,500,000 candlepower and the guide beacon light atop the control tower, 13,500,000 candlepower, is one of the brightest in the country and is designed to give the greatest available penetrability through fog and low clouds.

To give Cleveland its modern flying field, the WPA men laid down a landing mat 1,450 by 2,000 feet—the largest single piece of concrete ever produced, equal in area to a two-lane highway 36 miles long—and built a four-acre concrete apron and seven runways. In addition they moved the 400-foot grandstand used for the National Air Races a distance of 1,000 feet north and 2,000 feet west to eliminate the hazard on the approach from the west and filled in six ravines, the largest of which was a mile long, 200 to 400 feet wide and 90 feet deep! The completed airport contains 1,040 acres of ground. It is larger than three of the most famous European airports combined—Croydon in England, Le Bourget in France and Templehof in Germany. Its runways are 1½ miles long in the direction of the prevailing wind. The field is lighted by 500,000,000 candlepower at night. It has boundary lights at intervals of 200 feet around each edge. It is kept dry by an elaborate drainage system containing so many pipes that if placed end to end they would stretch almost 200 miles. These pipes are made of a special material porous enough to allow water to seep in within a few minutes after it hits the ground, but strong enough to support the weight of the heaviest planes.

To provide a West Coast air base the WPAers created, on Yerba Buena Shoals in San Francisco Bay, an island which by next year will become a key field linking transcontinental with transpacific air traffic. Last year this island was used as the site of the Golden Gate International Exposition. When the exposition has closed its gates for the last time, the entire development is to be quickly converted for airport use. The administration building of the exposition, a $715,000 structure, will be the airport terminal building. Two $400,000 exhibit palaces will be used as airplane hangars. A highway and trestle to the San Francisco-Oakland Bridge, built for use of the exposition crowds, will supply rapid connections between both these cities and the air base.

To create the island—now known as "Treasure Island"—the WPA built a 16,000 foot seawall containing 220,000 tons of rock, pumped 20,000,000 cubic yards of sand into the site, established a complete water supply and drainage system and constructed the bridge link already mentioned. The completed airport's landing area will be free from obstructions and will measure 3,400 by 5,000 feet. The three major buildings, the terminal structure and the two giant hangars will be concentrated in a group at the extreme south of the island. Off the shore on that side will be a protected water area for seaplanes, measuring 1,500 feet by 3,420 feet and dredged to a depth of 40 feet.

Such mammoth key airports constituted, of course, the more spectacular phase of the WPA's undertaking. But of equal significance, perhaps, was its building of hundreds of smaller ones in more sparsely populated areas. Salt Lake City, Utah, for instance, badly needed a first-class airport because five streams of cross-country air traffic converge there. The WPA filled this need by erecting a new administration building, constructing three paved runways and installing lighting and drainage systems.

Similarly the field at Sioux City, Ia., was improved by the building of new runways, taxi-strips, aprons, gutters and catch-basins, the construction of an adequate administration building and the placing of new gasoline pump and storage facilities. The airport at St. Paul, Minn., was modernized by the erection of permanent boundary lights and the building of a hydroplane dock. The base at Idaho Falls, Ida., got a new administration building, hangar, radio station, water system and heating plant. The one at Billings, Mont., got new floors and aprons for its hangars, new boundary lights, a new water supply and sewage system, and a new post office. Fields at Omaha, Grand Island and North Platte, Neb.; Elko and Ely, Nev.; Portland, Baker and Klamath Falls, Ore.; Dallas, El Paso, Houston, and San Antonio, Tex.; Birmingham and Tuscaloosa, Ala.; Niagara Falls and Rochester, N. Y., and dozens of other cities were enlarged and put into first-class shape.

All of these fields, of course, will be available for military use if war comes to the United States and, with this thought in mind, military air experts have given technical assistance to the planning of each. In addition, however, WPA workers developed or enlarged a number of strictly military fields for use as Army, Navy, and National Guard airports. Among the 30 Army fields improved were Riley and Maxwell Fields in Alabama; March, Crissy, Hamilton and Moffett Fields in California; Bolling Field in Washington, D. C.; Kelly and Randolph Fields in Texas; Scott and Chanute Fields in Illinois; Langley Field in Virginia and McChord Field in Washington. Navy air bases on which WPA workers labored included Reeves Field, California; Pensacola in Florida; Squantum in Massachusetts; Grosse Ile in Michigan; Cape May and Lakehurst

(*Continued on page 97*)

An important phase of WPA aeronautical operations is the painting of air markers on building tops. Projects like this are part of the $150,000,000 total spent on aviation.

Kenneth Carter, publicity man.

Holly Morse, assistant director.

"Curly" Lindon, assistant cameraman.

Plain Planesmen

by HILL EDWARDS

There are plenty of pilots in Hollywood—but they're not stars. They range from office boys to directors, all bound together by aviation.

Ernest Schoedsack

NOT long ago Peyton Watkins got an attack of the wanderlust. As it was vacation time anyway, he closed his office at Twentieth Century-Fox studio, cranked the prop on his two-cylinder *Aeronca* and headed east. He floated back into town 11 days later, having covered 11,000 miles to and from New York City, counting side trips hither and yon.

A short time later he decided to go north, piloted his craft, which he affectionately calls "Putt-Putt," up to the fringes of Alaska and came back again with a lot of photographs of the forests beneath.

We pick Peyton as an example because he isn't a millionaire. In fact, he readily admits that, as head of the fan mail department at the studio, he makes just about the same salary as you and I. He's one of between 200 and 300 of the Hollywood "rank and file" who, while the stars take bows for daring aeronautical adventures—many of them "dreamed up" by publicity men—sanely and sensibly go in for flying as a sport. Some own their own planes. The greater percentage rent from one of a score of operators at half a dozen different airports. Some have more than a thousand hours. Others are still in the student ranks and still others are so proud of private tickets that they'd like to pin them on their shirt fronts.

The money and the enthusiasm of these "plain people" have contributed much to keeping flying alive in southern California during the dark post-depression days and, now that the boom is on, more and more are going to flying fields to learn the ins and outs of piloting. A CAA inspector told me the other day:

"Some of the stars learn to fly for

Andy Houghton, studio messenger.

Ted Tetzlaff, cameraman.

Dewey Wrigley, process cameraman.

Peyton Watkins heads a studio fan mail department and has been flying 10 years.

publicity, but these unsung, unheroic fellows don't. They love the game and they fly for that reason alone. Nearly a third of the tests I give are to those employed in the 'small jobs' of the film industry."

But, to go on with Watkins. At the moment he is organizing groups of youngsters called "Avions." The organization is his own idea. Lads too young to take flying training are assembled in groups for talks by well-known flyers. They police fields during air meets and other events. They visit airport control towers, study CAA regulations, meteorology and navigation and the principles of flight.

Peyton's flying time has come the hard way. He learned to fly 10 years ago and has accumulated about 600 hours. During this period he has owned an *Eaglet*, a Waco, a Fleet and the current light of his life, "Putt-Putt." He got the urge after a flight with Tony Fokker in the first tri-motor ever flown in America.

Then there's Andy Houghton. Carrot-topped Andy is in Paramount's messenger department. Some day he hopes to be a producer but now, at 26, such a job isn't just around the corner. His time has come, since he first soloed under Ted Brown in the winter of 1935 in five, 10 and 15 minute dribbles. Andy says, after 165 hours:

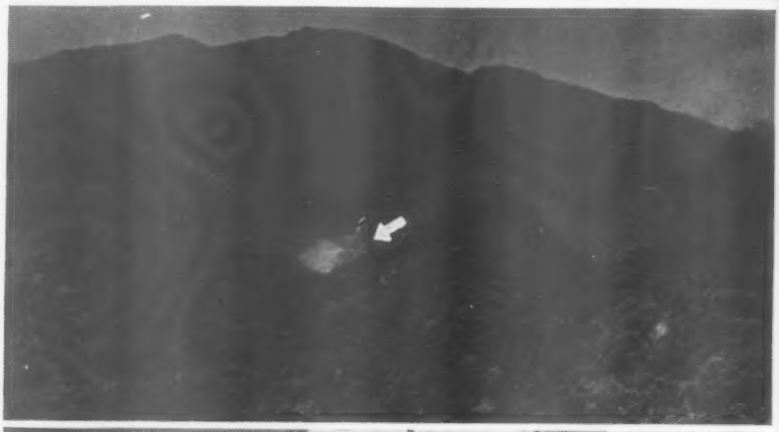
Lars Larson

"If I ever got enough time, I guess I'd go into aviation, selling planes and giving instruction. I'd forget all about being a producer. But right now, my flying is strictly amateur.

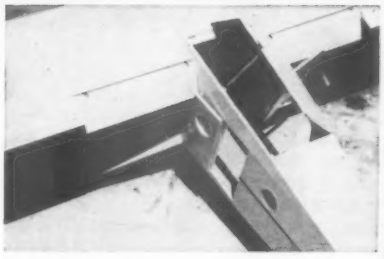
"I got interested watching ships at Port Washington, Long Island, when I was still in short pants. I came to California, met Russell Thaw, and went overboard on wanting to fly when he took me east in his Northrop. I got a lump sum together and soloed in December—the thirteenth—1935."

(*Continued on page* 70)

An Aerial Tight Squeeze



ONE of the toughest flying jobs in the business belongs to the pilot who flies the Bellanca *Aircruiser* above. The "airport" into which he has flown an average of 3,580 pounds per day for the past year is indicated by the arrow. Nothing more than a clearing, this field is deep in the Mindanao Mountains of the Philippine Islands. The *Aircruiser* is used for hauling freight to the Davao gold mine in the jungle. Its back has been cut open (right) to facilitate loading and unloading.



The 1940 Fairchild "24"

NEWEST Fairchild on the market is the version of the popular "24" shown below. It is powered with a 145 h.p. Warner *Super Scarab* which gives it a normal cruising speed of 122 m.p.h. and a range of 720 miles. Landing speed is rated at 48 m.p.h. Price for the standard "24" is $5,995; the de luxe model (powered with a 175 h.p. Ranger engine, sells for $7,230. Both models are four-place.

I Learned About FLYING From That! - No. 12

by GEORGE ARMISTEAD

This prominent pilot entered a race and spent most of those hours learning things. This is the story of a jinx airplane and a good flyer.

George Armistead

I LEARNED about flying from a blunt-nosed, souped-up Gee Bee that held 975 metal horses under its cowling and boasted a 14-to-1 supercharger.

It was a lesson that darned near cost me my life. And it was a tutoring session at 19,000 feet in a thunderstorm over Arizona with everything going wrong. Next day the newspapers summed it up pretty succinctly with this little paragraph: "George Armistead was forced out of the Bendix Race at Winslow, Ariz., because of engine trouble." That's a 16-word laugh!

I had engine trouble, all right, but I had a deuce of a lot more things wrong. In September, 1938, I had entered the annual Bendix cross-country derby with a plane built more than four years earlier—for Jacqueline Cochran's London-Melbourne attempt in 1934. Charley Babb, my boss and America's largest used aircraft dealer, owned this "hoodoo ship" that had never finished a major flight.

Even the Gee Bee type spelled Jinx (see POPULAR AVIATION, December, 1939). Cecil Allen, Russell Boardman and Lowell Bayles had been killed flying 'em in competition. Probably Maj. Jimmy Doolittle had the best experience with Gee Bee's, for he clipped a new record of 252.68 m.p.h. in one in the 1932 Thompson Trophy dash.

Mine was a slightly modified "Q. E. D."—which means "it has been proven"—version of the Gee Bee. Slightly less clipwinged, it *was* more maneuverable. But not very.

Before the big race, for which I'd been preparing as a pilot since I patched up a smashed Jenny in 1926, I shook my ship down on a cross-country hop that ended in a Texas soil erosion project near Amarillo. That should have warned me. The Gee Bee with its 975 h.p. *Hornet* was plain dynamite. Under 10,000 feet I had to hold 'er in. If I gunned the plane, the 14-1 supercharger would whip the engine into a million pieces. Naturally, I didn't. Twelve years of flying had given me a healthy respect for my equipment.

I'll never forget the dismal before-dawn September morning when my turn came 'round to take off from Union Air Terminal, Burbank, for Cleveland. Most of the gang had already headed east in their ships. There were Lockheeds, special racers and Beechcrafts. And, brother, it was as black as the inside of a deserted mineshaft! I trundled the Gee Bee to the starting line and waited. They'd crammed me into the cockpit and all around me were dials, radio apparatus and equipment for my oxygen mask. Suddenly, as I peered sideways out of the glass-covered hatch, I realized: "Armistead, you can't see the boundary lights for this take-off!"

This is the Gee Bee Q.E.D. flown by the author. It was known as a jinx airplane.

Nor could I. The Gee Bee's bulging flanks completely shut off my forward vision. And just as Starter Larry Therkelsen's flashlight swung down in the Go signal, I knew it'd be a dead-blind departure.

Despite my 400 gallons of gasoline—enough to get me to Wichita, but equally enough to overload the plane at 8,000 pounds—I managed to crawl over the fence at the end of the runway and start booming toward Cleveland. By the time I got into the skies I was scared as hell. But I climbed out through San Gorgonio Pass, pulling up to 14,000 feet, and began using ogygen. I bulleted toward the Colorado River with the airspeed showing doggoned near 300 m.p.h. and the old supercharger sending the *Hornet* into a whirling dervish dance.

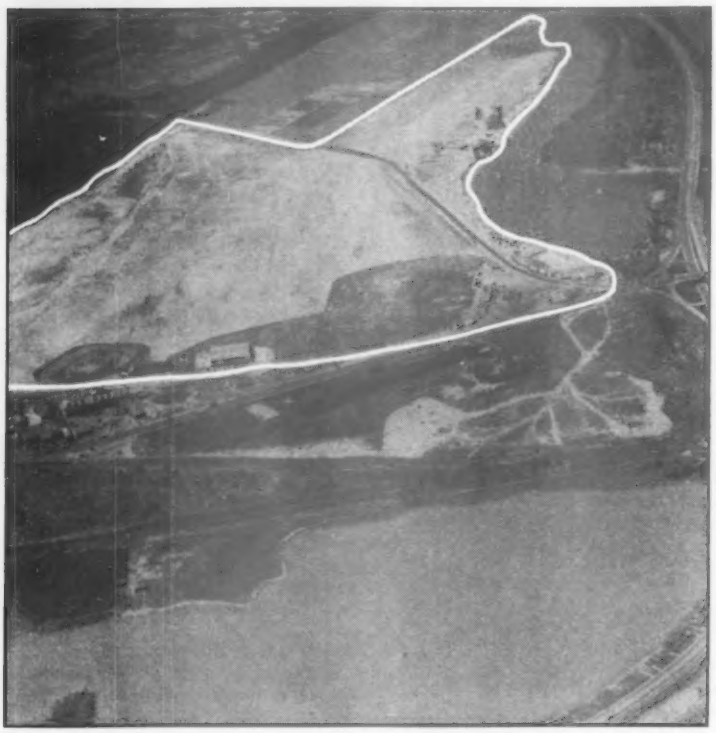
Over Kingman it started happening. In a routine scanning of my instrument panel, I suddenly noticed that the oil-pressure needle had dropped alarmingly. And the oil-temperature indicator seemed stuck against the boiling point peg. Brother, that was no fun! I figured a bearing had blown. But I was damned if I'd give up yet. That Bendix dough looked awfully good—and I thought maybe I could nurse the Gee Bee into Cleveland.

Because I didn't want to get stranded without an engine above the clouds, I tried to keep under the ceiling. That was considerably easier said than done. As fast as I'd drop down, so would the ceiling itself. I could see I was in for it.

And the weather! Like something over the Baltic Sea, it gave me the whole

(*Continued on page* 95)

WORST TO BEST



The white line bounds Washington-Hoover as it stands today. Note blimp hangar.

by JOHN C. A. WATKINS

★

Many an airline pilot has one or more gray hairs from operating into Washington-Hoover airport. President Roosevelt did much to promote the Gravelly Point field.

★

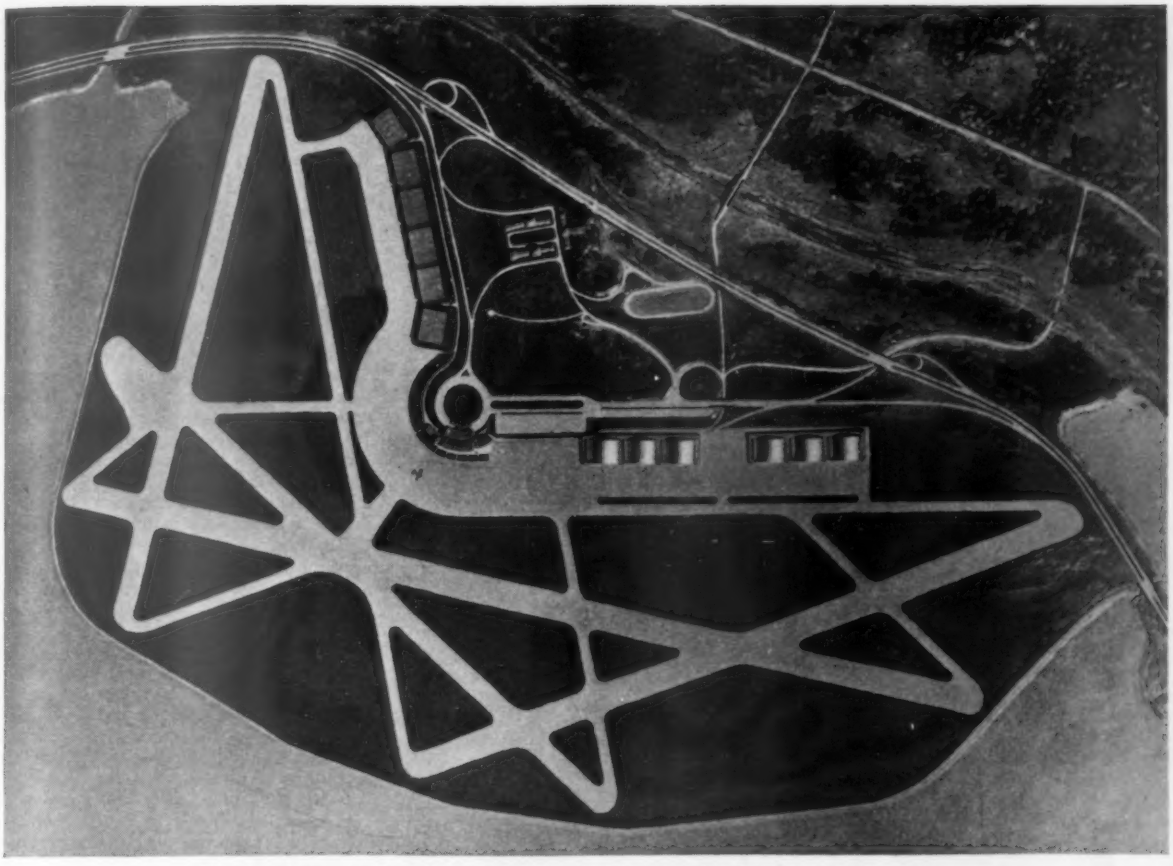
ACROSS the muddy Potomac from the city of Washington, D. C., there is rising from the Virginia shore an airport conceived in a President's dream and which should be one of the finest flying fields in the world. It will be equipped with every navigation aid known to a new Federal supervisory body for civil aeronautics, anxious to make its mark; plus contributions from 10 other Government agencies supplying their best brains to the project. Its runways will be long and broad, its taxiways smooth, its hangars ultramodern and its terminal impressive—even elegant. In short, the new Washington municipal airport—two or three miles from Washington's business district—will be a dandy.

By the time July rolls around and the firecrackers begin to pop, the flying field itself will be in shape for landings and take-offs. By Labor Day, transports will be loading and unloading cargoes of well-fed Congressmen at the very doors of that cross between Grand Central Station and Radio City Music Hall which is to be the terminal building or air station.

All this will come to pass by then provided the pilots, who have been easing ships into and out of the Washington-Hoover airport all these years, haven't succumbed to the paper dollies certain of them have been predicting freely they would soon be cutting if something weren't done to give the capital a decent field.

The new Washington municipal airport—perhaps national airport would be better, since it represents a national undertaking and is to be a model among model airports—is a dream field. One night President Roosevelt dreamed that he saw "a beautiful silver bird" crash, burst into flames and burn the occupants to a crisp. He heard the screams of the passengers as they tried to get out, and saw the big black banners in the next day's newspapers. All this happened, as you might have known, on the

This is the Gravelly Point terminal building from the airport. On left is presidential reception room.



This map-photograph shows the new airport as it will appear when finished. Note size of runways in comparison to airplane in front of administration building. Field is three miles from city.

Washington - Hoover Airport. That dream is going to cost the people of the United States in the neighborhood of $9,000,000, plus not more than $6,000,000 for all the additional expansion anticipated for the future. That isn't so much, when you remember that the field will be bigger than New York City's new municipal airport at North Beach, which already has cost more than $47,000,000 (the major portion of it from the national, not New York's, purse) and probably will cost a good deal more before they're through.

Anyway, no sooner had the President had his dream than he called in the young Civil Aeronautics Authority, a site was selected on the Virginia side of the river just across from the army's new Bolling Field, and work got underway. Part of the job involved hydraulic fill, sucked up from sand and gravel deposits on the bottom of the Potomac, part levelling of a hill back of the boulevard to Mount Vernon and part moving the boulevard itself out of the way. A good portion of this job has been done.

The airport will be 750 acres in extent, with four main runways which can be paralleled with other runways whenever the need arises. All of them will be paved and the longest will be 6,875 feet. The others are to be 5,300 feet, 4,820 feet and 4,200 feet. There will be miles of taxiways.

"Approaches from eight directions are clear and safe," Robert H. Hinckley, chairman of the C.A.A., said recently. "For miles in each direction it is possible for a plane to approach the runways at an angle as flat as 40 to 1 (Hear that, Mayor LaGuardia? Listening, Baltimore?) without flying over congested areas.

"When an instrument landing system is finally adopted, as it will be soon, it may easily be applied to such a field as this. Structures are grouped within an angle of about one-tenth of the

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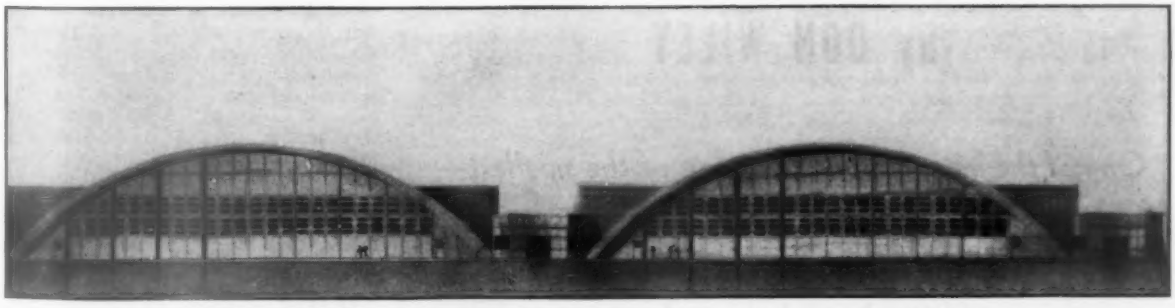
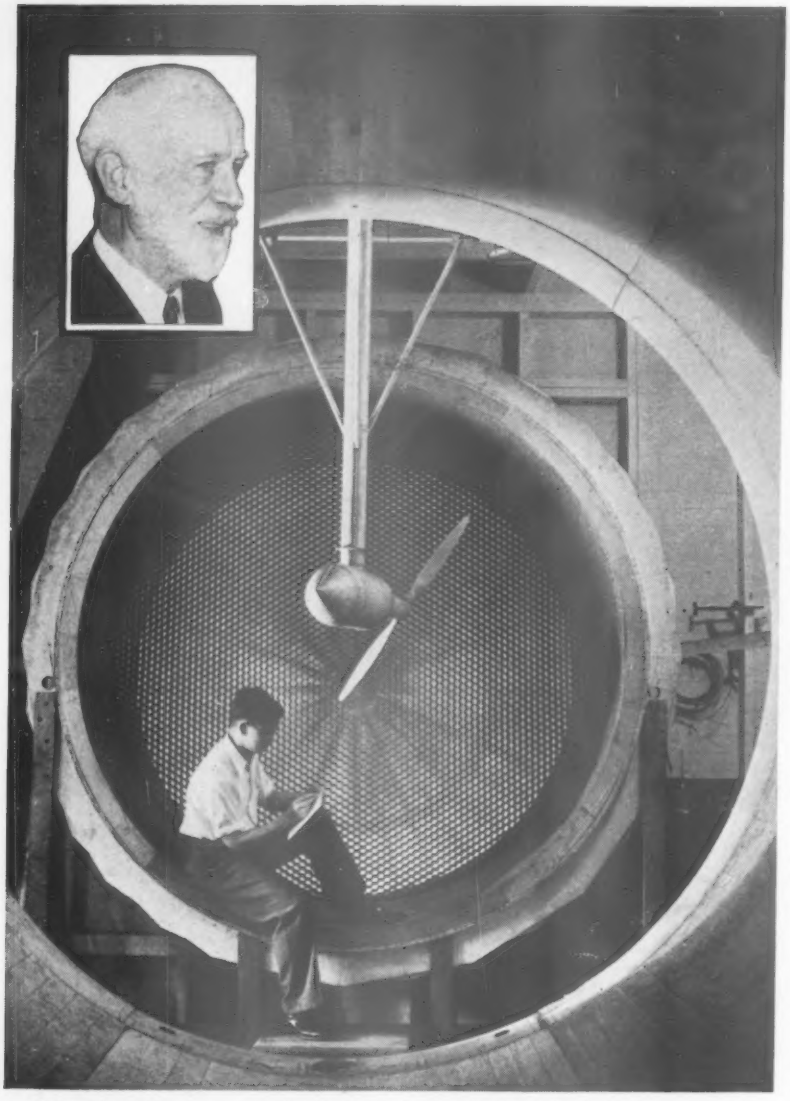


Six hangars like these are being built at Gravelly Point. Doors are 30 feet from top to bottom.



Outstanding research on propellers has been done at Stanford. Inset: Professor Durand.

LILLIPUT LAB

by DON WILEY

One of the most famous—but one of the smallest—aerodynamic laboratories in the world is at California's Stanford University. Many important aviation problems have been solved by its men

WHEN, in the not too distant future, scientists of the National Advisory Committee for Aeronautics arrive at Sunnyvale, Cal., to staff the $10,000,000 research station Uncle Sam is building there, they will find a countryside not at all unaccustomed to wind tunnels and similar mysteries. For nearly a quarter of a century of aeronautical research has been carried on in a laboratory not 10 miles from Sunnyvale's vast dirigible dock. It is an unchallenged fact that the work of the Aerodynamic Laboratory of Leland Stanford University has had a profound and lasting effect upon the development of modern aircraft.

Compared with Langley Field or the new gargantua being created at Sunnyvale, Stanford's laboratory is lilliputian. It has but one wind tunnel, compared with Langley's 19. Its funds are limited. Its enrollment never exceeds 14 students a semester. But what Stanford's lab lacks in size it makes up in quality. Its propeller research has won international recognition. Its studies of the behavior of airplane structures under stress have contributed materially to the production of commercial and military aircraft. And nearly 50 of its graduates are now engaged in top-flight aeronautical work, several of them at Langley Field, the others in the aircraft factories of the nation.

Aviation had just emerged from its swaddling clothes to don the armor of war when Stanford's air lab was established. In 1915 President Woodrow Wilson called together the best minds of aviation in America and formed the National Advisory Committee for Aeronautics. Among those experts was Dr. William F. Durand, professor of mechanical engineering at Stanford. In the winter of 1916 he and E. P. Lesley, another mechanical engineering professor, built, at the behest of the NACA, Stanford's first wind tunnel. It was a shaky affair of wood and canvas, but in it they pioneered in the field of propeller research for, with the exception of some experiments conducted earlier by Gustav Eiffel of Paris (builder of the famous tower), the Stanford researchers were working in a new realm.

In the files of the NACA you can still find a paper—the 14th to be published by the National Advisory Committee—in which Professor Durand wrote of "Research on Air Propellers". For 10 years that paper was the bible of propeller design. Today it is still widely quoted. Since those days the Stanford lab has won recognition as the leading center in the United States for propeller design research through the medium of reduced scale model tests. The NACA has published 22 papers by Stanford men about these studies. The NACA, the Army and private manufacturers have put their findings to widespread practical use. In fact, this research has had a fundamental effect upon development of the hydromatic, full-feathering props used throughout the United States and most of the rest of the world today.

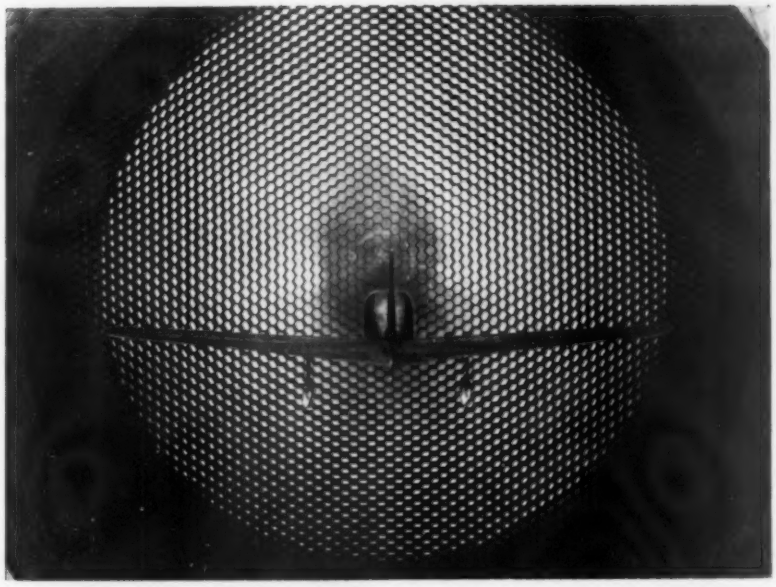
Stanford's research on counter-rotating tandem propellers has been watched

with the keenest international interest. The Army conducted lengthy tests with this type of prop mounted on a Curtiss P-36. In a paper published by the NACA (which requested and financed the experiments) Professor Lesley revealed that identical, counter-rotating, two-blade, close-spaced, tandem propellers, adjusted in pitch to absorb equal power at maximum efficiency, have from 0.5 per cent to four per cent greater efficiency than that of four-blade props of the same blade form and designed to absorb the same total power. While inferior in efficiency to single two-blade propellers for blade angle settings at 0.75 revolutions of less than 35°, the tandem props have an appreciable advantage in higher blade-angle settings, Professor Lesley found. It is interesting to note here that certain of Britain's Schneider Cup racers, as well as the Italian seaplane that held the world's speed record of 440 m.p.h. for so many years, were equipped with tandem props.

The Stanford lab has a museum composed of some of the most fantastic propellers ever conceived by man. During World War I, when the United States was searching wildly for anything that would give the Allies air supremacy, the War Department was invaded by scores of inventors with air screws "guaranteed" to revolutionize flying. One by one these props were sent by the War Department to Stanford to be tested. Today they cover one wall of the lab. Some are slotted. Some are shaped like sickles. Others bear strange curves and wrinkles. None of them were worth a darn, but the lab tested them all carefully.

The present Stanford wind tunnel, third of a series that began with the rickety affair of 1916, is a wooden, open-throat type, eight-feet in diameter, with a maximum wind velocity of 95 m.p.h. created by a 12-foot, eight-bladed fan capable of 500 r.p.m. Here graduate students test propeller power impulses, lift and drag of wing sections and pitching, yawing and rolling characteristics of scale model planes. In a nearby building, Stanford conducts research into the behavior of airplane structures under load. Much of this work is done at the request of the NACA, which turns to the university for frequent checks on theoretical findings made at Langley Field. This section of the laboratory is full of fantastic machinery designed to apply tremendous pressures. Huge screws pull relentlessly down on pieces of metal (one of the machines exerts pressures up to 200,000 pounds) while careful measurements are made.

Here the Stanford lab has measured the amount of beating unit structures, stressed skin, built-up spars and other airplane parts will take before they begin to twist, buckle or collapse. The researchers have supplied the NACA lately with some valuable information on how new types of channel stiffeners will react when compressed. By developing new methods of stress analysis, adaptable to special conditions, the university has been able to collect and publish valuable data on the behavior of various aluminum alloy structures.



The present Stanford wind tunnel is only eight feet in diameter and has a maximum velocity of 95 m.p.h. created by a 12-foot, eight-bladed fan capable of 500 r.p.m.

Started as a research center, the Stanford laboratory received a $195,000 10-year grant in 1926 from the Guggenheim Fund for the Promotion of Aeronautics and thereupon branched out into the formal training of aeronautical engineers. Today its graduates are important cogs in the booming aircraft industry of southern California and other parts of the nation. One Stanford man, John Buckwalter, was project engineer for Douglas' giant DC-4. Another, Leo Devlin, Jr., was chief engineer for the DC-4's "little brother", the DC-5. The structural problems relating to the tricycle landing gear which is standard equipment on both ships were worked out by Stanford graduate Fred Allen.

Much of the designing of the new Curtiss-Wright stratosphere liner, CW-20, was done by two Stanford men, Bruce Richardson, project engineer at Curtiss' Buffalo plant; and Lloyd Englehardt, chief of structures for the same outfit. Max B. Harlow, president of Harlow Aircraft, is a Stanford graduate. Garner Green, assistant chief of structures for Consolidated; Reid Bogert, chief of stress analysis for the Douglas El Segundo plant; and Donald Story, chief of static testing for Douglas at the big Santa Monica plant, are a few more of the Stanford lab men employed by the aircraft industry.

At Langley Field, a Stanford graduate, John F. Parsons, directed construction of the 19-foot pressure tunnel. Another Stanfordite, Russell G. Robinson, was largely responsible for the design and construction of the eight-foot high speed tunnel there. Two others, Carl Babberger and Ogden W. Odenheimer, have conducted many important experiments in the giant 30 x 60-foot tunnel.

In recent years the two founders of Stanford's laboratory—Professors Durand and Lesley—have retired, leaving Professors Elliott G. Reid and Alfred S. Niles to carry on their work. Reid came to the university from Langley Field, and Niles from the Air Corps research station at Wright Field, Dayton, Ohio. These men are elated over the decision which brings the nation's newest research station to Sunnyvale. With that plant in operation, students at the Stanford lab will have an unparalleled opportunity to observe at close range the most advanced research in aerodynamics, hydrodynamics, structures, instruments and power plants. But it is safe to say that Sunnyvale will profit, too, by the proximity of the Stanford University Laboratory.

The Stanford counter-rotating propellers.

END

License Refused

A 19-YEAR-OLD student at the Massachusetts Institute of Technology recently was denied a private pilot's license by the Civil Aeronautics Authority in one of the most unusual cases on record. The student, Bruce L. Dunbar of Boston, was rejected by the C.A.A. on the basis that he had a lengthy record of traffic offenses and suspensions and revocations of his automobile driver's certificate, as well as "instances in which he displayed lack of proper caution in operating or attempting to operate aircraft." Dunbar's record showed that, during the last two years, he had been guilty of eight speeding charges and four other charges in Massachusetts and New Hampshire. In conclusion, the C.A.A. report (which followed a hearing in Boston) said: ". . . We find that (Dunbar) . . . has demonstrated a singular disregard for the laws of Massachusetts and New Hampshire . . . and has persisted in defying the legal authorities of those states. We further find that these same tendencies were, prior to our denial of his application for a private pilot's certificate, becoming evident in his operation of aircraft . . . (His) deficiency lies in his lack of mature judgment, his tendency toward recklessness, his lack of respect for laws designed for the protection of the public and his attitude of defiance toward those whose duty it is to enforce those laws . . . The interest of public safety requires us to deny (his) application."

Australian Engines

NEARLY 250 high-powered British engines are being shipped to Australia to equip *Beaufort* bombers—said to be the fastest in their category in the world—which are to be built in Australia. Commonwealth production of complete aircraft is expected to be in full swing in 1941. Exchange arrangements now concluded provide for 80 Australian technicians to go to the engine factory at Bristol, while 20 experts from the parent works will go to Australia. The *Taurus* 1,065 h.p. engines are of sleeve-valve radial design and are being used on many late types of British warplanes.

Millions of Pilots

THE American Institute of Public Opinion recently conducted a survey throughout the United States to determine how many Americans would like to learn to fly. Forty-two per cent of the country's population, according to the completed survey, wants to learn. That's approximately 50,400,000 people! The question asked by the surveying organization was: "If it didn't cost you anything would you like to learn to fly?" A surprising number of women said they would be interested.

Lightplane Direction Finder

ONE of the first lightplanes to be approved with complete radio receiver, transmitter and direction finder is the Aeronca *Chief* shown above. The radio equipment consists of a Lear AMRL-1, Lear AMT-1 and direction finder. The interior view directly above and at left shows the transmitter behind the plane's seat; at right is the new transmitter's microphone with the loop antenna in the background. This equipment makes the lightplane an excellent cross-country ship.

The New Rearwin

LATEST Rearwin model on the market is the three-place *Cloudster* shown below. Known as the Model 8135, the new ship is powered with the 120 h.p. Ken-Royce engine. It differs from previous *Cloudster* models in that a third seat has been added behind the regular single side-by-side seat of previous models. Fully loaded to a weight of 1,800 lbs., the new ship has a top speed of 140 m.p.h., cruises at 125 and lands at 48. Range is 625 miles, service ceiling is 16,000 feet. Wing span is 34.146 ft., length is 21.5 ft. and height, 7.33 ft. The standard fuel tankage is 34 gallons. Brakes are mechanical, tail wheel is steerable.

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

AOPA NEWS

By GILL ROBB WILSON

EIGHTY percent of all persons who purchased private aircraft during the last eight years sold their ships within two and a half years and did not buy others! Fifty percent disposed of the craft within two years and a third cashed in the equipment within one year. So run the statistics of the CAA on private ownership. Between 1931 and 1936 fifteen thousand aircraft were sold to private owners. However so many owners disposed of their ships that the net total increase of private owners for that period of time was less than 300. In short almost three thousand new purchasers must be found each year to maintain the status quo of private owners.

Mr. Hinkley in giving out these figures wants to know *why?* The AOPA wants to know why? There is only one way to get the answer. That is to ask you.

Why honestly did you get rid of your airplane and why did you not buy another? Was it cost of mechanical maintenance or fuel or storage? Did the reason have anything to do with money? Or did you just get tired flying when learning to fly lost its thrill? Or did you have a good scarce and decide flying put too much pressure on you? Or was private ownership too much of a drain on time? Was the airport too far from home and flying too much inconvenience? Did you sell because winter operation was too much trouble? Just *why* did you get rid of that ship? If we only knew we could do something about the reason and get you back into the owner class. Won't you take a few minutes out and write to me about it? Tell me what kind of ship or ships you have owned and why you let them go or why you have kept yours. The reasons we keep them are as valuable as the reasons we let them go.

The Private Owner Market

With thousands of men and women learning to fly there should be an ever increasing private owner market. The cost is down to comparison with automobile purchase and upkeep. Maybe we do not have enough variety? If you could have just the combination you want of speed and landing speed and take off performance would you get a new plane? Are you waiting for something that will take less skill to fly or service? Or are you stymied because you can not go the places you want to go by using an airplane? You realize of course that we must develop a private flyer market for aircraft if private flying is going to be a powerful component. AOPA knows the manufacturer has been making valiant efforts to get you what you want. But it is difficult to know what you want without getting your viewpoint. You can definitely help. Come thru!

The Planned Training Program

Remember, the flying has been during universally severe winter weather. Yet the accident record in the colleges has been phenomenal. Looks as though the standardized instructors and students are going to prove something. It will pay every fixed base operator to study the picture closely. The big drawback to instruction has always been the crack ups. There is gold in them thar hills if we can avoid the repairs. But let us stop any cut throat competition. The operator who gives instruction without a fair profit on his merchandise isn't doing aviation any good. He may think he can undersell with cheap instruction and make it up on sales and rentals. But it can't be done. The place to standardize on business as well as on method is at the point of instruction. We know a few places where an operator will get down to three fifty or four dollars an hour but either he is unfair to the instructor whom he hires or he has to slight maintenance. Neither can build an industry.

Good News from the Record

The year started with ten thousand ships in American civil aviation. It ended with almost thirteen thousand. Nineteen thirty-nine also started with about 23,000 pilots and ended up with better than thirty-one thousand. The greatest increase was in the light plane category of course. Anyone who saw Al Williams' Cavalcade to Florida will realize that. It was rumored that the farmers down South Carolina way thought the bees were swarming when Al and his chillen passed over and ran out with new hives and nets over their heads.

The National Airport Program

At last it looks as though we were getting down to cases on this airport business. Millions and millions have been wasted because there was no nationally correlated plan. Many communities and individuals developed airports only to find they were without utility or strategy. Many a community got disgusted and plowed under.

Now what is needed? First each state should set up its own plan with relation to population, terrain, recreation, industry, commerce, etc. Then these plans should be fitted together like the sections of highways are fitted. This is the function of the federal government in cooperation with the states. There will be found to exist overbuilding in some sections, lack of building in other sections. When the big job is all done and the various state plans made into a sound national plan, serving every component of aviation and not merely the trunk lines of commerce, then the policy of proportionate responsibility for development should be fixed. We are dead against the idea of raiding the federal treasury for a vast sum while letting the states and municipalities shun their proper share.

The federal government has one great stake to think of first in such a program and that is national defense. Interstate commerce and mail are other factors they must consider. All right, what does that call for from their standpoint. Perhaps it calls for federal expenditure of funds primarily for preparation of terrain. Adequate runways, approaches, lighting and navigational facilities and control of traffic. It is not sure that the federal government is justified in spending fifteen cents for storage facilities, administration buildings, airport fences, beautification, grandstands and the like.

Some believe the states are mainly responsible for providing the land which the federal government is to improve. This because the states have the power of condemnation, because they need give no thought to township or county lines, because they can zone approaches and airport locations and use the agencies of state government and equipment to assist in a hundred different ways. Certainly the program should be participated in by directly affected municipalities. Perhaps erection of hangars, administration buildings, power units and such kindred adjuncts should be their responsibility. Maintenance should

Forty AOPA members and friends were guests of Braniff Airways on recent courtesy flights over Chicago. Flights were door prizes at first AOPA Chicago Unit meeting.

fall here also because the great majority of municipalities have equipment which might be used without additional outlay.

Where possible existing airport locations should be utilized whether they are publicly or privately owned. A twenty year lease is sufficient evidence of intention. By all means let us take advantage of what we have.

The big idea in the whole program is to keep it American. If we insist that the federal government take over the entire load we can expect that the program will be developed purely from the federal standpoint . . . defense . . . mail . . . commerce. If the private owner and pilot wants his component of flying to get a fair share of consideration he must be prepared to spark plug his community into accepting a fair share of responsibility. Over the water the national governments took over the works and non-scheduled flying got the works. If we yell subsidy, subsidy, subsidy we will doubtless get it . . . in the neck!

Down In Washington

Wishing to economize as sincerely as possible (and we are with them on that) the Senate felt it might be wise to lop a little off the airway maintenance and operation budget. The cut would have meant disuse or limited use of about three thousand miles of airway now being constructed or already finished in this fiscal year. Since that might have affected safety very gravely (no pun intended) we hopped down to see would the gentlemen kindly leave the fixings. They went very carefully into the matter and agreed with us that nothing should be done to create a single obstacle to the most perfect safety that could be attained. So they put the million back and the beacons will be turned on when the juice is connected up. Now don't one of you birds go and run into one of them.

Confucius Did Not Say

If an airport control tower uses its radio to inform a pilot he owes a landing fee, the pilot has a claim to wonder if that is a proper use of radio under the Federal Communications Commission.

If a landing fee is five dollars and you bounce three times do you owe the Czar fifteen bucks or does he owe you ten?

If it costs two-fifty to land, why shouldn't it cost twenty-seven cents to cross over the airport at ninety-four feet.

Information Please: If it costs ten cents to play peek-a-boo at the ships and fifteen cents for a tour of the hangars and twenty-five cents to park your car, how much does it cost to stay away from an airport where it costs nothing to walk on public property?

The pay-to-smell-the-bay-bilge-tax referendum has been lost by a nose.

When is a landing fee not a landing fee? When a pilot says "To heck with the place."

Spring is coming. Don't carry too high a tail on the take-off on the wet sod.

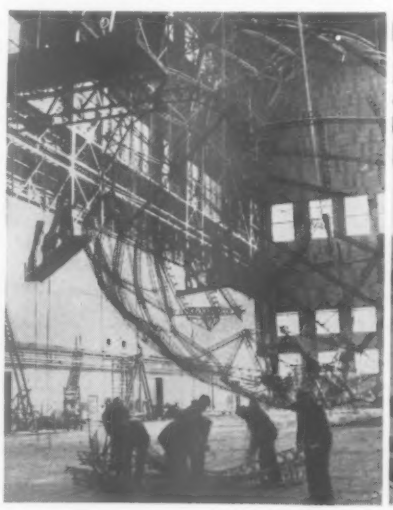
(*Continued on page 78*)

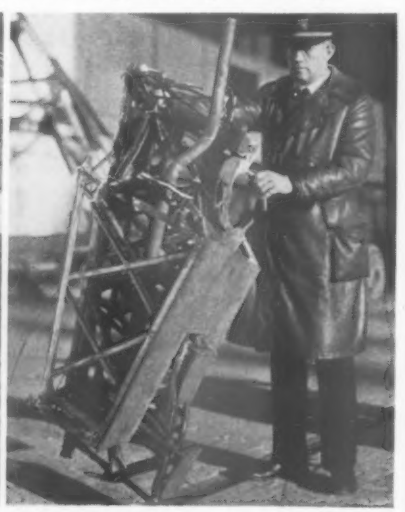
Flying Signboard

THE old Boeing 80-A airliner above is carrying the world's largest flying electric sign; a sign big enough to be easily readable from an altitude of 3,000 feet. Developed by the S. S. Pike company of New York, this flying billboard uses 1,000 separate bulbs. Power is produced for the electric system by a four-cylinder gasoline engine inside the plane's cabin. It, in turn, has a 4½ kilowatt electric generator which has an output of 4,500 watts. This entire generating unit is shown at right. The Boeing is one of those gigantic tri-motored airliners once used by United Air Lines on its coast-to-coast system. Powered with *Wasp* engines, these ships originally cost $110,000. Pilots generally conceded them to be the easiest-flying of all large aircraft. This was due to the Boeing's massive two wings which gave it an unbelievably low landing speed.

End of the "Los Angeles"

LYING in a metallic grave are the remains of the famous old *U. S. S. Los Angeles*, the dirigible sent to the United States Government by the Germans in November, 1924. She was ordered wrecked for scrap by the Navy Department recently after 15 years of service. Below (right) is the last piece of the *Los Angeles* en route to the scrap heap. The Navy used her for training and experimental work for 10 years, then tied her to her mast at Lakehurst, N. J., awaiting dismantling.





Retractable Landing Gears

by RAOUL J. HOFFMAN

THE increase of the power output of an engine will not advance the maximum speed by equal amount. If the design and weight of a regular commercial airplane is kept the same and the horsepower is increased by 100 per cent, the speed will increase only 30 per cent. Reducing the power loading has not been the only remedy.

Looking at the tabulations in Section 1, values of equivalent flat plate areas of a production machine built 20 years ago and that of a present day super-streamlined machine are compared, we see that reducing the outside area, eliminating the struts, providing turbulent-free air ducts for cooling liquid or air-cooled engines and retracting the landing gear reduced the drag area by 70 per cent. The biggest gain has been the housing of the landing gear.

The retracted landing gear must be placed within the wing or the fuselage in order to have less resistance than a cantilever streamlined landing gear. Section 2 illustrates a full cantilever landing gear with shock absorbers concealed within the fuselage, which has the same resistance as the wheels retracted half way into the leading edge of the wing. From this it follows that the protruding wheels must be faired, to be of any advantage.

The credit for inventing the retractable landing gear goes to the builder of the first rubber-powered model airplane in 1875, Penaud. Even after airplanes were successful, the retractable landing gear offered too great a problem of weight, design and stress to be readily applied to an airplane, for the added weight did not improve upon the top speed.

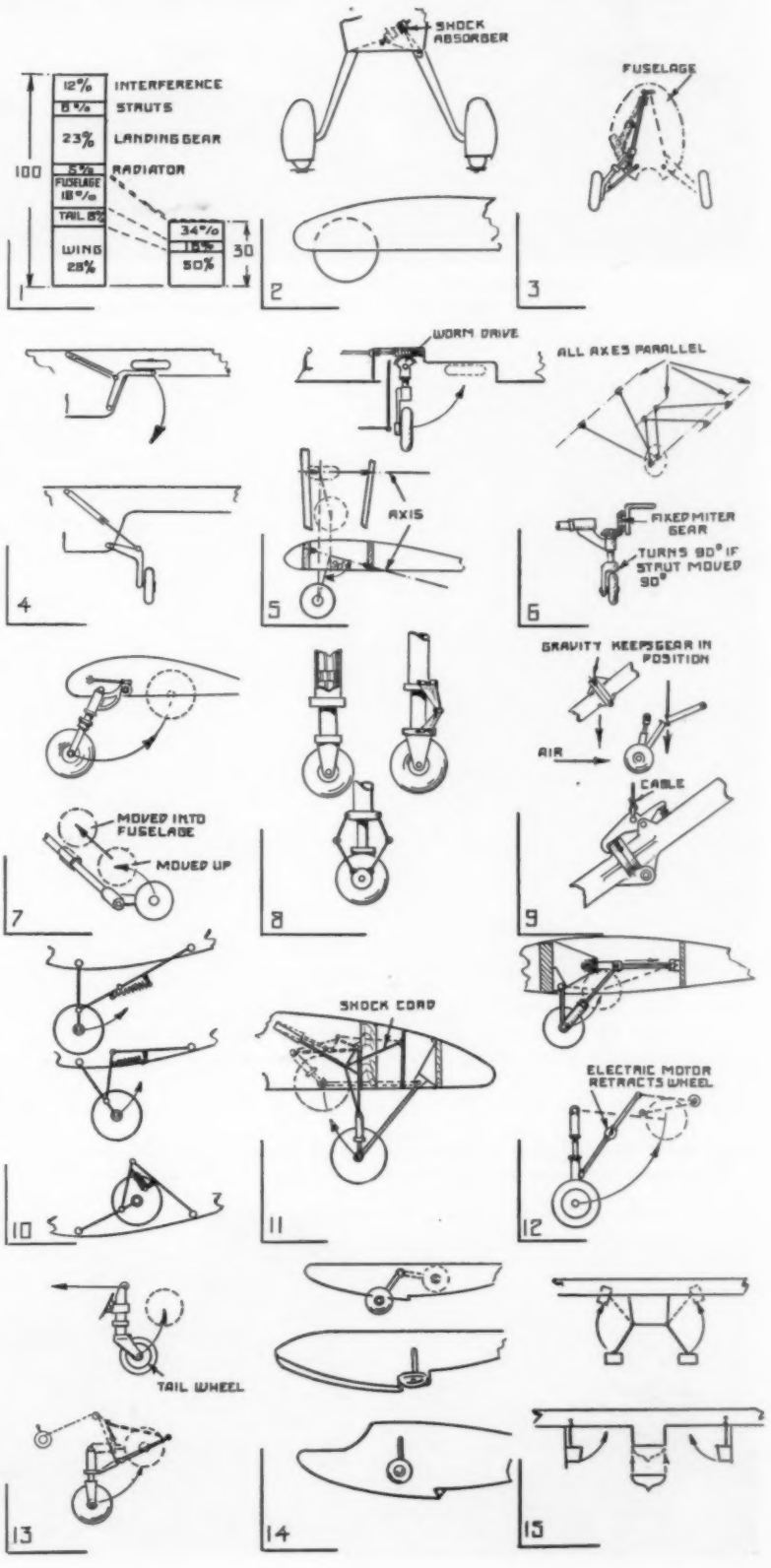
Up to 1909 the Wright brothers used the catapult, which enabled them to leave the gear on the ground and land on skids. This idea looked very promising that time, for it would have eliminated the mile-square airports by placing the simple wood catapults at 10 to 15 mile intervals.

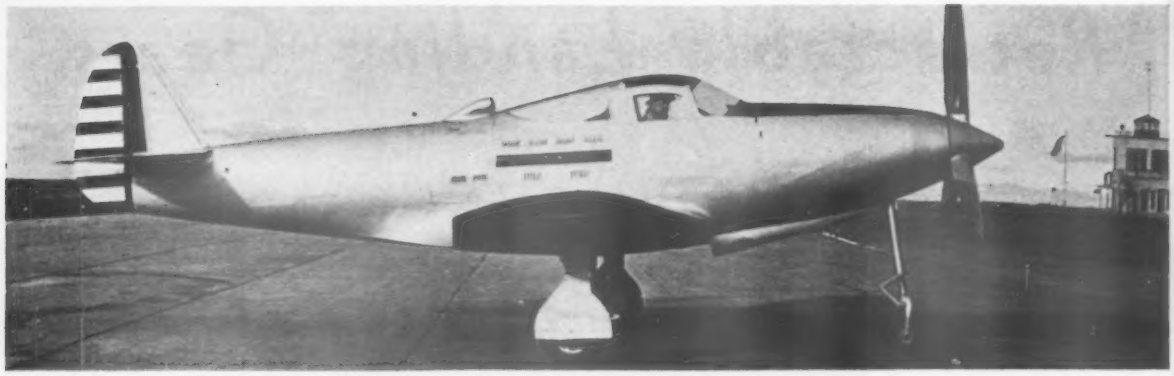
Later, many long-distance flyers dropped the landing gear to break the standing time or distance record. Usually a locking device stopped the propeller in a horizontal position for safe landing.

The use of retractable landing gears was impeded by the thin airfoils used on biplanes. The cantilever monoplane, with its thicker sections, permitted retraction without enlarging any outside dimension. At present, all high-powered commercial or military airplane have retractable landing gear. The added manufacturing cost of a retractable landing gear on a lightplane prevents their general use.

Retracting the wheels may be accomplished laterally or longitudinally or

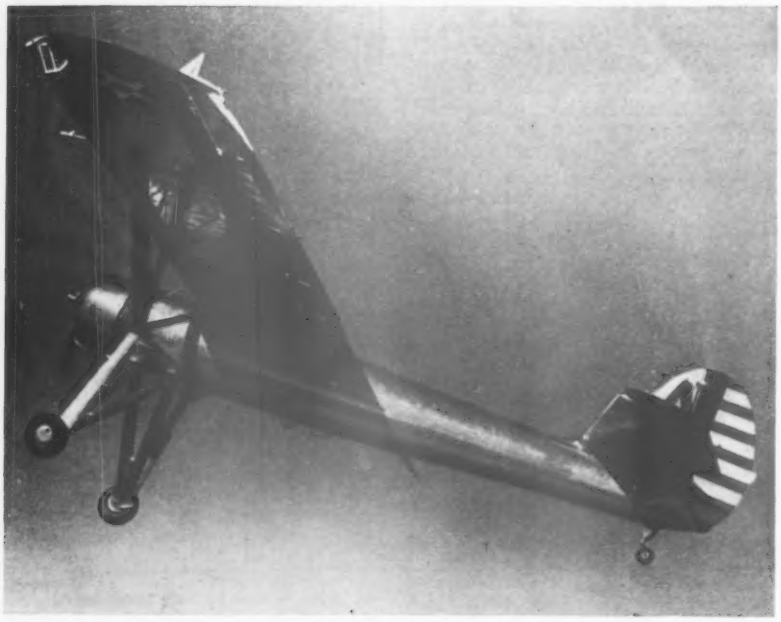
(*Continued on page* 94)





Latest photograph of the Bell "Airacobra" clearly shows the unusual engine and landing gear arrangement. The Allison engine is behind the pilot and drives propeller on a shaft. Top speed is over 400.

HAVE YOU SEEN ?

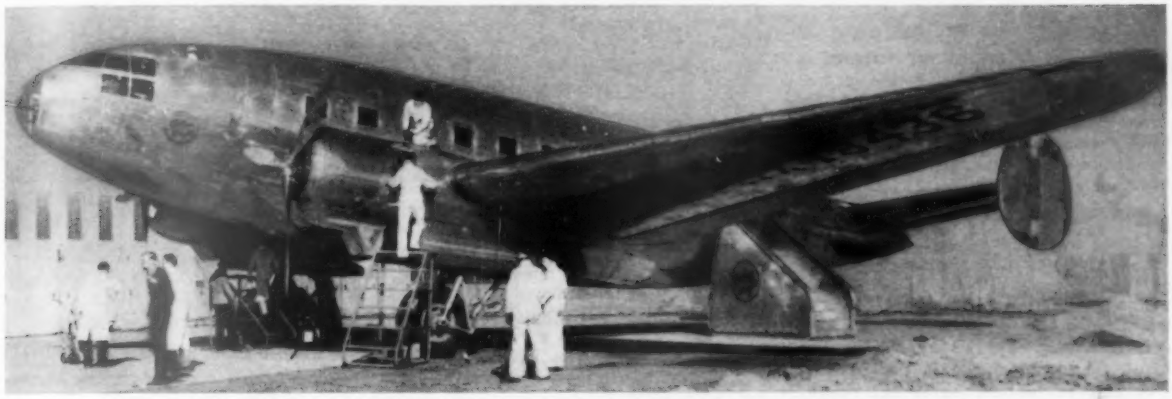


First of the Army Air Corps' revolutionary new observation types to be test flown is this Ryan YO-51. Picture shows off its complex system of slots and Fowler flaps. Stinson and Bellanca are building similar types. All resemble German Fieseler "Storch".

Newest winter device is this Vulcan engine pre-heater, good for engines from 90 to 1,000 h.p. Entire unit weighs 126 lbs.

The Naval Aircraft Factory at Philadelphia recently bought up the SOC design from Curtiss and now is producing these observation biplanes under the designation SON-1.

Not often seen is this Douglas-Northrop BT-1 torpedo plane. It is based on Army's A-17A attack model which has a top speed of 260 m.p.h. and cruises at 205. A few BT-1's are used on carriers.



Making its first appearance for test flights is this twin-engined Curtiss-Wright CW-20. Its two 2,000 h.p. engines carry 36 passengers 243 m.p.h. Range is 1,500 miles. No purchases have been reported.

A new design by Vernon W. Payne is this two-place monoplane recently test flown. Top speed with 65 h.p. engine is 105, range is 450 miles. Wing spans 37 feet; built-in slot is used. Ship has no ATC.

Latest adaptation of the Consolidated PBY has novel machine gun blisters on both sides of hull and a new tail assembly.

Another new lightplane design is this Durand A-45. Engine is 45 h.p. Szekely. Top speed is 102 m.p.h., cruising 85.

Model Building Tips

by PAUL W. LINDBERG
Model Editor and Designer

THIS month we deal with useful hints adaptable to gas models. From time to time we have received letters from model builders suggesting that we show in detail various parts of importance. This article deals with the more important ones and should solve a lot of unnecessary guessing on the model builder's part.

Battery Details

Under battery details in the accompanying drawing we have shown various ways of installing batteries. These are installed quickly through the use of cellulose tape. This tape can be purchased at any drug, novelty or dime store. Meanwhile, soldering the wires at the battery terminal is a sure method of getting the proper amount of current to pass through the wires. Many model builders use elaborate battery cases but, after a great deal of experience, we find the method shown here to be the simplest.

Motor Mounts

Shown in the drawings are four different types of motor mounts; all are practical in every respect. In designing a motor mount, the builder must bear in mind that a bent or broken motor mount is better than a damaged crankshaft. The hardwood mount shown in the drawing should be made from birch, oak or any other hardwood. The size of the mount for any one-fifth or "C"-class motor should measure approximately ¼ inch by ½ inch through cross-section, lengths to suit. Make sure these are fastened securely in fuselage. Some model builders arrange their mounts in such a way that they may be removed from fuselage if broken and new ones slipped in place. The other mounts are clearly shown in detail and are quite satisfactory.

Exhaust Stacks

Oil from the exhaust stack (if the stack is too short) soaks the model's covering, causing a weakening both in structure and covering. Illustrated here are various types of stacks which are easily made. Aluminum or thin sheet metal can be used with good results. In fastening the metal straps around the cylinder to the exhaust stack, do not attempt to solder them in place as they come loose from the heat of the engine. Rivet them in case you use aluminum or steel. If thin sheet steel is used, it may be riveted or brazed in place. Many model builders seek an exhaust stack that extends below the cowl. In bending such a stack, it is advisable to fill it with sand or a loose-fitting spring. Then heat it over a gas flame and bend to the desired shape. Stacks that extend well beyond the sides of fuselage or cowling will keep your model from becoming covered with excess oil from motor.

Cowls

The methods of making cowls shown here produces not only lightweight units that may be had in almost any shape. To make such a cowl, secure an ordinary molding clay. Work this on a flat surface until you have the proper shape. Next, secure some ordinary airplane tissue and cut into strips ½ inch or wider, depending upon the work for which it is intended. Before applying these to the molded clay pattern, brush on a thin coat of plaster of paris and allow it to dry. This coating will allow the coat of clear dope (applied next) to dry. Work the tissue strips around the pattern, using a small amount of dope on a brush to make them adhere to the molded pattern. As many layers may be applied to justify the particular job. Fillers, such as used on filling porous wood grain on solid models, may be applied to gain a smooth exterior finish. Allow the cowl to remain on the pattern for one day or more, so that it will not lose its shape when removed. Make sure it is thoroughly dry.

Landing Gears

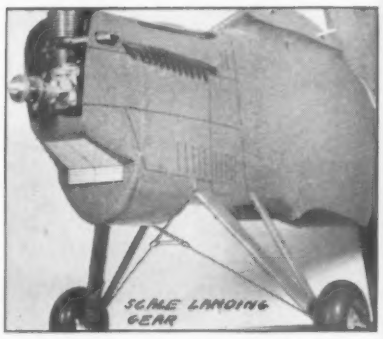
Landing gears are a constant source of trouble to most model builders. Many designs will not stand up under hard abuse. The single-strut type, shown in the drawing, is adaptable for light models. No shock absorbing devices are built into this type, as the piano wire itself is flexible enough to absorb most rough landings. But models of larger sizes must have sturdier landing gears. Hence we have shown a type which uses rubber bands as a shock absorber. The rear part of landing gear which is attached to fuselage must be strongly hinged at that point. This particular landing gear has given little trouble and is highly recommended.

Models which require authentic scaling must revert to a more highly detailed strut. The one shown has a shock spring concealed within its tubing. This process has been used successfully on authentic scale models but requires a little more patience in its construction.

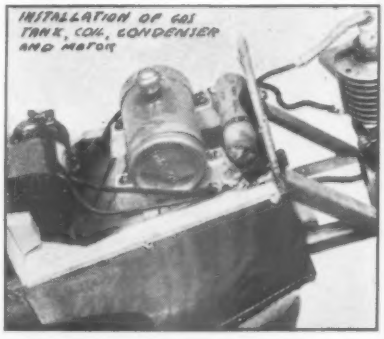
Leading Edges

Three different types of leading edges are described on the drawing. Figure 1 deals with a leading edge that has a thin sheet of balsa formed over the top and bottom part of ribs, approximately ¼ to ⅓ the distance back from entering edge. This type of leading edge maintains a more uniform air foil section. Veneer should be very thin so as to prevent any ridge along the ribs when covered. Figure 2 deals with the ordinary solid type leading edge, together with false ribs. This is the most widely used leading edge because it is far simpler to construct, although it is not efficient as Figure 1. Figure 3 has a hollowed-out leading edge which is carved, shaped and cemented to the ribs. Apply the same distance back from the entering edges as in Figure 1. Always make sure that leading edges are uniform the entire length of wing as this adds to the efficiency of the air foil section.

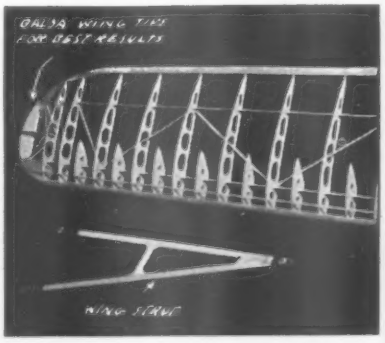
END



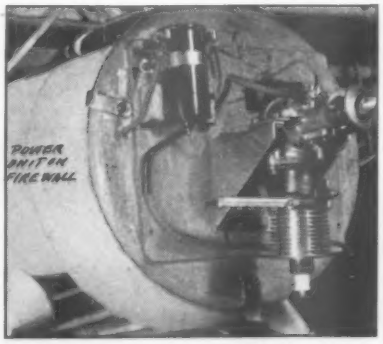
Heavy gas models require sturdy landing gears; tubing conceals a shock spring.



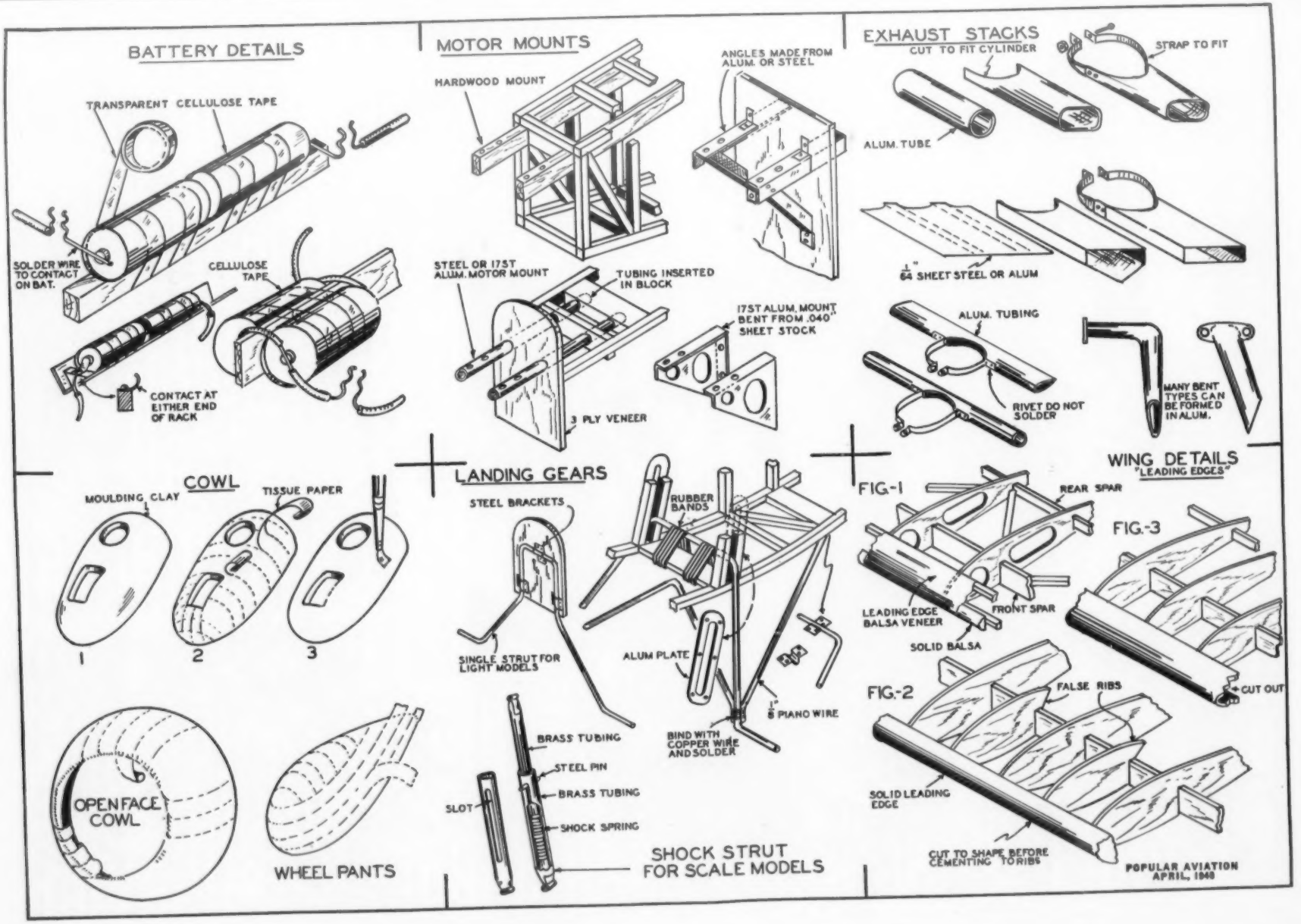
Hardwood motor mounts are best suited to gas models, preventing engine breaks.



There are many short-cuts for the builder in wing construction. Note clean design.



This is gas engine mounted inverted. Note excellent adaptability to clean cowling.


BATTERY DETAILS
TRANSPARENT CELLULOSE TAPE
SOLDER WIRE TO CONTACT ON BAT.
CELLULOSE TAPE
CONTACT AT EITHER END OF RACK
MOTOR MOUNTS
HARDWOOD MOUNT
ANGLES MADE FROM ALUM. OR STEEL
STEEL OR 17ST ALUM. MOTOR MOUNT
TUBING INSERTED IN BLOCK
17ST ALUM. MOUNT BENT FROM .040" SHEET STOCK
3 PLY VENEER
EXHAUST STACKS
CUT TO FIT CYLINDER
STRAP TO FIT
ALUM. TUBE
1/64 SHEET STEEL OR ALUM
ALUM. TUBING
RIVET DO NOT SOLDER
MANY BENT TYPES CAN BE FORMED IN ALUM.
COWL
MOULDING CLAY
TISSUE PAPER
1
2
3
OPEN FACE COWL
WHEEL PANTS
LANDING GEARS
STEEL BRACKETS
RUBBER BANDS
SINGLE STRUT FOR LIGHT MODELS
ALUM PLATE
1/8 PIANO WIRE
BIND WITH COPPER WIRE AND SOLDER
BRASS TUBING
STEEL PIN
BRASS TUBING
SLOT
SHOCK SPRING
SHOCK STRUT FOR SCALE MODELS
WING DETAILS
"LEADING EDGES"
FIG-1
REAR SPAR
FRONT SPAR
LEADING EDGE BALSA VENEER
SOLID BALSA
FIG.-3
CUT OUT
FIG.-2
FALSE RIBS
SOLID LEADING EDGE
CUT TO SHAPE BEFORE CEMENTING TO RIBS
POPULAR AVIATION APRIL, 1940

Seaplaning Is Fun!

(*Continued from page 22*)

other. They are not to be landed willy-nilly on hills of water any more than landplanes are landed on ridges and ditches. A seaplane can be put down and taken-off of water far rougher than the hard ground the same ship could use on wheels, but even so the obligation is just as strong on the seaplane pilot to find a smooth landing surface as it is on the landplane pilot—only there are tens of thousands more available places for the seaplane.

With merely the information covered here so far, the normally intelligent person can start his seaplane flying with confidence. Long before his first season is over he will have learned just as well by observation as by instruction, the vagaries of wind, waves and current, and most of all, curvilinear motion. They yield to perfectly natural laws that have only to be felt out to be understood. Approaching taxiing with a dash of caution, the beginner soon finds his ability and accuracy growing rapidly. When in doubt, he just anchors. It's all so simple. The only mystery is why no one ever learns how not to occasionally fall overboard!

Another bugaboo more apparent than real is the maintenance problem. The whole story boils down to keeping salt water from drying off the ship, as it leaves a corrosive deposit behind. This is done in two ways; by keeping it off with a layer of grease or other protective coating, particularly in the crevices and crannies, and by washing it off in fresh water. The next best thing is to leave the floats in the salt water so that they won't dry off, though the wings and the fuselage above do dry under these conditions. The ship should be prepared all over before the start of a season, and the fittings and working parts thoroughly greased, but these specifications are now an old and well understood story. As for washing, the best is just to hose it off with fresh water as she comes out of the salt, though it is still simpler to make a couple of bad landings in a fresh water lake and souse her in her own spray—and keep her based there. That's all. Certainly there is nothing very complicated in this problem and, if the owner meets the specifications, he need no longer worry that his plane is deteriorating, even if it should not get that hosing-off for several weeks at a time.

Sometimes people hesitate to put their plane on floats because they will have to leave it outside, either moored or on a beach. While this is not desirable, they should remember that they are saving from $100 to $150 a season on hangar rent and that saving will more than pay the services of a good mechanic and his helper for a week to recondition the ship and make up for the ravages of exposure at the end of the outdoor period. There will be enough left over each year to soon pay for a recovering of the plane a year or two earlier than normal, so that he need not feel that enforced outside storage is very expensive. Also, a thousandth of an inch of steel makes many thousandths of an inch of rust. It looks bad, but do not be alarmed. Just clean it off and repaint. The important thing is to be sure the ship gets the going-over at the end of the outdoor period. The proposition would be expensive only when it accumulates.

No one should check their yen to own a seaplane by waiting for better or cheaper floats. When better and cheaper floats are made, Edo probably will make them—and probably several other firms, too—but you are the key to that problem. Lower prices will come only from volume of sales. That process is already well under way and accelerating yearly. Frankly, we do not know what a better float would be; lighter of course, but the efficiency of our metal floats is hard to challenge. Perhaps new materials will come into the picture. Resin-bonded plywoods certainly bid well to revive the popularity of wood and should prevent all but a small portion of the water absorption of the early wooden floats. They often picked up as much as 50 pounds of water in the course of a season. Bakelite plywood should also nearly stop rotting. We do not feel that wood any longer has much advantage over sheet metal in the way of repair, but both are simple.

"Every time I send Abercrombie out to check the port engines, he gets lost! . . ."

When true plastics come into the picture (Bakelite bonded plywood is *not* a plastic) very likely their first structures will be seaplane floats. After a while this has fair promise of leading to better floats—but don't wait for it. Also rubber-and-fabric inflated floats are a bright star on the horizon. Extreme light weight, shock absorption and resistance to dents and holings would be among their advantages and, although we can't now list their disadvantages, there is little doubt that there would be a list sufficiently long to bring their all around desirability down to strong competition from other floats. Not the least of their problems would be less protection in the event of forced landings on land, a feature now recognized as one of the greatest assets of a seaplane.

The Patent Office has granted a hundred impractical patents for skids, fourth wheels, guards and whatnot to make it possible to land airplanes in really confined spaces where they can skid to a stop without nosing over or rolling on their landing gear into obstructions. None of them have made the grade except the simple retractable landing gear which, when so used, makes a skid of the delicate lower wing or faired bottom at fairly great cost to the unfortunate owner. Only recently have we realized that a pair of floats makes a perfect solution to this problem, their long bows preventing nose-overs and their rugged, widely-spaced keels, making an acceptable landing area out of the smallest and roughest clearings.

Flying is fun when you fly relaxed. You are relieved when you have the knowledge you can effect a safe landing any time. Seaplane flyers now have that feeling when flying over practically any terrain and water (all but the long exposed stretches) and that is more than we can say of landplanes. It now is a proven fact that seaplane flying over land is safer than landplane flying and a darned sight cheaper if a really rough small field is the only spot to get down in!

This year, more than ever, seaplanes have places to go where they will find their own little floats to tie up to. Some 50 of these, mostly in the northeast section of the country, were established last year and more than twice that number will be commissioned in early 1940. They are located on strategic points at city water fronts and in vacation centers. Sponsored and completed by the funds and efforts of the National Youth Administration, the plan was also fostered by the Private Flying and the Airport Sections of the C.A.A., the Seaplane Pilot's Association and the Private Fliers Association. With distinctive markings, the little bases stand out in any harbor and provide sure docking and

(*Continued on page 66*)

THE NEW COMPLETE PIPER CUB COUPE

Spacious interior, as styled by Harry S. Pack, well-known industrial designer. Note the finger-tip instrument grouping, two-tone Naughyde upholstery and chromium-plated control sticks.

First IN FAVOR

BECAUSE IT IS

FIRST IN *Value*!

PIPER leadership has never been more dramatically demonstrated than in the new Piper Cub Coupe. You've heard about the quiet, effortless performance of its muffled and completely-cowled engine. You've admired the beauty of its smooth, swift-flowing lines from spinner to trimming tab. You know from experience the operating economy of Piper Cubs. Now complete the picture. Put yourself in the pilot's seat of the new Coupe and fly the ship that's already "First in Favor" among pilots the country over! There's a free demonstration waiting for you at a nearby airport.

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No extras to buy with the new *complete* Piper Coupe! In addition to those popular features of last year, standard equipment includes a stainless steel exhaust muffler, parking brake, glove compartment and all-metal, locking doors. With a Lycoming 65 h.p. engine, $1948 . . . with a Continental 65 h.p. engine, $1995 . . . as little as $650 down.

DOWN PAYMENT PRICES START AT

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FOR THE NEW PIPER CUBS

The famous Continental 40 h.p. Piper Cub Trainer is now priced at only $995 . . . the Lycoming and Franklin 50 h.p. Trainers, $1298 . . . the Continental 50 h.p. Trainer, $1368 . . . the Continental 65 h.p. Trainer with dual ignition, $1598 . . . the Lycoming 65 h.p. Coupe, $1948 . . . the Continental 65 h.p. Coupe, $1995 . . . the new three-place Cruiser with dual-ignition Lycoming Geared or Continental 75 h.p. engine, $1798. Coupe and Cruiser models have 2-S rating. All prices F.A.F. Lock Haven, Pennsylvania.

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Piper Cub

OUTSELLS ALL OTHER LIGHT PLANES COMBINED

(*Continued from page* 64)

tie-up facilities and, in many places, specification fuel and oil as well.

When flying up or down a river or along a coastline, a seaplane can definitely improve weather reliability because it can fly under really bad weather always in a position to land and cancel out at a moment's notice when it really shuts down tight. A doubtful flight can be started under such conditions with no worry about the dangers of a forced landing, the only concern being for the annoyance of the possible cancellation part way to the objective. Usually the objective will be made when a landplane could never have considered starting with any degree of prudence.

There is no limit to how low a seaplane can be flown! The law states that it must not be flown less than 300 feet over open bodies of water, but since there is no very good reason for this law, it is openly and universally disregarded. At least it determines the responsibility if there should be an accident. If a plane can be flown less than half a wing-span from the water, there is a definite increase in speed from the cushioning effect, but this is close enough to require steady vigilance and should never be done in a large plane with an aisle in which the passengers can move around. There must be no sudden change of balance. However, a 50-foot altitude is a whale of a lot of fun and the author counts among his best flights a hop from Tampico to Galveston with the keel just above the surf line and the wing just skipping comfortably above the sand dunes. We were playing roadside cribbage with jack-rabbits and antelope!

Seaplanes are the royal way to mix family and flying. Many a man has had the problem of stimulating an apathetic wife to join him in the air. It is often a perplexity for the same reason that airplanes are hard to sell—one has to bring the prospect to the plane and not the plane to the prospect! But no one will deny that wives are 100 per cent sold on summer places at the shore or the lakes. Then it is only necessary to bring the airplane there—on floats—and let nature take its course. Nine times out of ten she'll solo before the summer is over. After all, wherever we play, we play on water—be it sea shore, lake or mountain for there are always lakes mighty close to the mountain resorts. A dude ranch? Yes, perhaps that is an exception.

Here is the clinching argument! One can save the cost of a seaplane, and a tidy reserve for operating expenses too, in the property value of his summer place alone. The seaplane makes accessible a better camp, in wilder country, further from business and at *much* less cost than one in the crowded areas near fast train service and concrete roads.

We're beginning to sound like a salesman, so we won't say more except to quote the following about a seaplane flight in the Canadian Maritime Provinces, from a boy to his mother:

"The doctor flies as I would if I owned a ship. He has no set objective or route planned ahead and he has a fine camera. Every five minutes we circled to get a shot—a little French town with a high protective wall against ice in the winter; an impoverished settlement with the wealthiest possible cathedral rising out of its center; an old work boat; the Falls of Montmorency; a group of French fish wiers; and a perfect shot right into the windows and onto the lawn of the Manoir Richelieu at Murray Bay.

"Monday morning we flew back to Quebec and took on a prodigious quantity of fuel. Leaving there at two, we had five hours and a quarter of the finest flying I have ever known—around the Gaspe Peninsula and into the town of Chatham, Nova Scotia, for the night. Gradually, almost imperceptibly, the low fields and swampy shorelines became a little more humped and a little more wooded until at 600 feet we were sliding along below the top of a rugged coastline with a calm sea below, each headland about a degree further to the south than the preceding and each mound getting a little higher above us and a little steeper. A thin white road chased along with us, most of the time pinched between precipitous cliffs and a tearing line of breakers, but here and there it would dart inland, a few seconds later to come sliding down off a huge mountain behind and far above us. Farms disappeared and there were towns with no visible means of support.

"Finally the towns crept in from the coast and took refuge in crannies in the hills. We would sail along an unbroken cliff until about two miles ahead we would see a little irregularity. The doctor would yell to Bob to take a picture and almost before he could get ready, we would be looking into a 'door' in the rock leading to a deep round hole in behind the cliffs with a collection of houses, a minute field or two, a little river sprouting from a long waterfall, a stone jetty at the entrance and before we could take it all in we would be past and the rocks would slide together leaving an unbroken stone face.

"For 150 miles this went on and then the tip of the Peninsula was a dream. We turned south and skipped from point to point across the mouths of the bays. At one point we photographed a sea-rotted rock, the likes of which I never knew existed on this continent and must surely be the equal of the Needles off Folkestone. It was isolated and towered perhaps 300 feet up from the surf, yet was only 150 feet across its very flat top. About 600 feet long, it had a perfectly curved arch cut clear through from one side to the other near its outer end. A smaller shaft but just as high shot up a few hundred feet further out.

"Then the sun started to settle, the sky was all pink and blue and lacy and our bottoms began to get sore. The country began to flatten out and whole fleets of identical little chubby schooners all outward bound sailed under us. We all felt quite drunk as we floated down into the long shadows of the little protected quiet and fishy-woody smelling harbor of Chatham where we anchored as simply as a small yacht, went ashore, devoured a dinner and fell asleep in an 1869 hotel.

"An hour's flight over calm sunny seas in the morning brought us to Shediac, more summery looking than anything we had seen and a little more familiar. We were right behind the Prince Edward Islands and where the Italian flyers landed last year. We taxied up to a wharf alongside a Northwest Mounted Police plane (an American Fairchild) and swapped ideas with the English pilots as we gassed from a hose off the wharf. We all went in swimming in lovely clean water and not so cold and, after leisurely drying off, got back into the ship in our trunks and flew across to Moncton and the Bay of Fundy which was still half dry land though the tide was already half in. The New Brunswick coast along here is like Mount Desert for miles . . ."

* * *

Seaplaning—it's wonderful!

END

$75 Starts Your
1940 BOWLUS SAILPLANE
Bowlus Sailplane kits are 80% factory finished and can be expertly assembled by anyone using simplest tools who follows printed, illustrated instructions. Kit sold in 10 convenient units or complete for $425, plus nominal crating charge and freight.
The Bowlus Utility Sailplane is the ideal trainer yet it's the American high performance champion and the crowning achievement of Hawley Bowlus, ace designer and builder. Send today for illustrated literature.
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Let us help you start a soaring club.
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Flying Is Healthy

IT IS the opinion of a group of recognized medical authorities who have studied the subject that flight is less fatiguing than other forms of travel. Those with heart disease who are physically able to be up and around and capable of attending to ordinary business affairs on the ground, may fly with no ill effect and with less exhaustion than by other means of transportation.

. . . it's the Odds-on Choice by a Wide Margin

Seems like everybody's going
TAYLORCRAFT

Listen to the talk of fliers who have flown and compared today's light airplanes. You'll quickly notice the extra enthusiasm — the more favorable comments for Taylorcraft. Discriminating people are amazed that such beauty, style and craftsmanship can be bought for so little money. It just seems like most everybody would rather own a Taylorcraft.

Take a trial flight yourself — see and feel the difference! You, too, will find that Taylorcraft handles more smoothly, more responsively, more surely, than any other low price plane. You'll surely praise its snappier pick-up, positive stability, all around superior performance. Yes, your own comparison will prove that Taylorcraft out-flies them all. It's the plane you'll prefer to fly and choose to own.

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The new 1940 Taylorcraft is available in 65-60-55 and 50 H.P. De Luxe models and the new Trainer with modern side-by-side seating and interchangeable wheel or stick controls.

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for 1940

AMERICA'S MOST MODERN LOW-PRICED AIRPLANE

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TAYLORCRAFT AVIATION CORPORATION
DEPT. 34 ALLIANCE, OHIO

Book Bug

(*Continued from page* 35)

issue—for Robischon has found that foreign publications, especially the Japanese, often carry information on United States fighting craft that are still "secrets" as far as our own journals are concerned!

The young collector—just bidding adieu to his twenties—is a member of the research staff of the Guggenheim Aeronautical Foundation at the California Institute of Technology. He maintains his library at his home at 1240 N. Central Ave., Glendale, Calif. Some day, he hopes, it will be housed in its own building.

Robischon's collecting first took the form of leisure hour prowls through book shops on the trail of more curios like "The Aeroplane Speaks." New finds whetted his appetite. He haunted second-hand stores, book auction houses and like establishments. He studied classified telephone directories of southern California cities to see that there were no such stores that he had missed.

Then he found "diamonds in his own back yard." The firm of Arthur H. Clark & Co. in Glendale, Robischon was amazed to learn, actually specialized in finding out-of-print or obscure old books! Through it he systematized his buying—first ascertaining what had been printed on a given phase of his subject and then commissioning the specialists to find it for him.

The process was expensive, but profitable. Robischon dealt with the firm until he learned their methods and then became his own "specialist." His first personal triumph was the purchase of the complete library of old Rockwell Field—for $15. Rockwell, scene of many of the Army's earliest air heroics, lost its books when the field was decommissioned. They were piled into boxes with an assortment of other Government "junk" and sold at auction. Years later Robischon found them gathering dust in a San Diego warehouse.

"The man who was paying storage on them regarded the aviation books as a liability," Robischon recalls. "He bought them in the first place only because they were part of a 'job lot' in which were also a number of agricultural books he coveted. It was a case of bidding on all or none. He looked positively sorry for me when I offered him $15—but he took it," Robischon chuckles.

Another source of many of Robischon's best items was Harry Reynolds, an aeronautical engineer who owned a number of early technical references Ernest adopted a different technique this time—he bought several of the most up-to-date areonautical engineering handbooks he could find, then casually offered to trade. Each party to the deal today solemnly believes that he outtraded the other!

Then there was the postman who commented on Robischon's growing mail from far places, all of it seeming to be about airplanes. The mail carrier confessed that he, too, had been quite a reader on aviation years ago, but that he had "kinda let it go lately." Cautiously Robischon pressed the conversation. Sure, the postman had some books he'd sell. Piled out in the garage somewhere. . . .

The treasure at the end of this trail was "A Textbook of Aeronautical Engineering" by Henry Woodhouse, which described and pictured World War airplanes—a truly historic volume, long out of print, which contains data on the aircraft of every nation engaged in that conflict. It is one of the most popular references among the authors and students who have learned the way to the Robischon home. (Visitors to the library form a fast growing fraternity. Authors and literary research experts, especially from the motion picture studios, have found its shelves an Eldorado of authentic data.)

"Him? Aw, he hooks a ride with us every time we fly over this way. . . ."

In 1936 the young collector's interest in the evolution of flying outweighed all other considerations. He made a pilgrimage from book store to book store until he found himself in Denver just in time for the "Mile-High Air Races" of that year. Funds were low, so he wangled a job as a member of the racing crew of Marion McKeen in order to see the speed classic. Robischon stayed with the McKeen racing plane after the meet to travel the rest of the circuit. McKeen paid his expenses and Robischon used his own funds for a coast-to-coast book shopping tour.

Back home and broke—literally—in January of 1937, he one day visited Caltech, principally to meet and talk with Dr. Theodore von Karman, director of the Guggenheim laboratory. Dr. von Karman was kind enough to show Robischon through the Foundation's classrooms, shops and laboratories, winding up the tour in the reference library. When he left Robischon had talked himself into the job of reorganizing the library's research facilities! He has been at Caltech ever since—except for vacation trips in search of more books for his own shelves.

Major accomplishment of his 1938 vacation was his visit to Dayton, Ohio, where he was accorded the privilege of going "behind the counter" at the Army's aeronautical library and museum at Wright Field. Even more interesting, however, was his visit with Orville Wright. Both events make one story. . . .

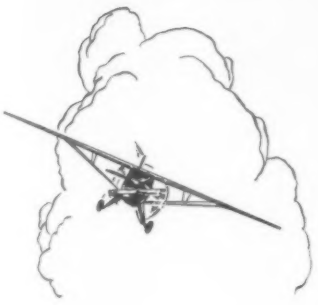
Robischon had armed himself for his descent on Wright Field with his prized copies of the Wright plane drawings. They proved an open sesame to the Materiel Division and its high command, who immediately asked for — and of course received—permission to photostat them. The history of the drawings is almost melodramatic. They give directions, down to the last wire and fitting, for construction of the Wright "Model A"—immediate predecessor to the Army's first airplane. Orville Wright had taken the plans to Paris in an attempt to sell a flying machine to the French government. (It was a later, improved model that the United States bought in 1909.) Mr. Wright's drawings disappeared while he was in Paris. A year later they turned up in the Wright mailbox in Dayton, postmarked from an American city but bearing no other clue to their travels.

This much Mr. Wright told Robischon two summers ago. Few others in this country even knew of the episode. Robischon, compiling his library section on the Wright brothers, had covered American and British sources thoroughly and was seeking material in other languages. A hint came from France—the trail led across the Rhine. One day the mail brought a dog-eared technical publication from Germany. It was a back number more than 20 years old of a semi-official engineering journal—and contained the detailed Wright drawings!

Even today only Mr. Wright and Robischon know all the details of their unauthorized publication. If the full story is ever told, says Robischon, Mr. Wright will have to tell it.

Early last autumn Ernest packed his bags and headed eastward again. Here are the high spots of a five weeks' Robischon junket from Glendale to New

(*Continued on page* 88)



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WHEN you buy a LUSCOMBE you get the fastest light airplane on the market. This fact was definitely established when Edward J. Walz of Camden, New Jersey, streaked over a 100-kilometer closed course at 118.746 miles per hour in an all-metal LUSCOMBE on January 30th at Floyd Bennett Field, Brooklyn, N. Y. This speed set a new national record for light airplanes. The LUSCOMBE used was a stock airplane with the addition of wheel pants and an adjustable pitch propeller and was fully licensed.

Performance is but one superior quality of this most modern airplane. Compare its streamlined beauty, strength of construction and long life with any airplane priced $1,000 higher and you will discover why LUSCOMBE has received such unanimous acceptance. It *is* a better airplane from any point of view—performance, flying characteristics, appearance, economy of operation, long life, comfort and value.

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THE ALL-METAL PLANE THAT SELLS FOR LESS THAN $2,000

For folder and further information, write Dept. P

LUSCOMBE AIRPLANE CORPORATION
West Trenton, New Jersey

Plain Planesmen

(*Continued from page 50*)

Moving up a notch or two on the financial scale you find a quiet, bespectacled young man, Jerry Fairbanks. With 2,000 hours, a record which rates from 1926, he bids fair to top the amateurs who fly even if their names aren't on the marquees. At the moment, Jerry is president of Los Angeles Aviation Country Club. He didn't have much wherewithal when he started, but today he has the top spot in Scientific Films, producing short subjects for Paramount release. He owes a gull-wing Stinson and has flown all over the United States.

"Frank Clarke taught me to fly," he relates. "I got the bug during the making of an aviation serial in 1925. I think I learned to fly in self-protection. If you've worked with Clarke, you know that you have to be ready for anything."

Jerry has owned five planes, the first being an open job. He has had four Stinsons.

Dewey Wrigley is a process camera man. As he lines up a camera with his hat on the back of his head he looks nothing like a flyer with 500 hours to his credit. But he is. He started flying in 1931. He explains:

"I was in the infantry during the World War. I used to look up from muddy trenches into a clear blue sky and see a lucky devil roaring overhead, clean and comfortable up there—and going places. I decided then that if I ever had the money, I'd learn to fly myself."

It wasn't until 1931 that he could afford the venture. Time had been up around $25 and $35 an hour and he hadn't been able to make the grade. He sought out Howard Batt, motion picture stunt pilot, and soon soloed. He has owned several planes since that time.

Floyd Hendrickson, head of the contract department at Metro-Goldwyn-Mayer, owns a Fairchild he bought last April, second-hand. He acquired the desire to fly when a boy in South Dakota—year, 1906. He watched pusher biplanes and decided that some day he'd own his own. Paul Mantz soloed him in 1935, and he now has about 250 hours.

When you talk of Hollywood veterans you have to name John Fulton, also a process cameraman. John got into the mood about nine years ago, when he worked at Universal. The company decided to make an air picture.

"You're the patsy," he was told. "Line up equipment."

He says:

"I picked the equipment because it looked clean. The cleanest stuff I could find belonged to Paul Mantz. He had just come down from San Francisco to start picture work. We signed him. Just about the time we made "Air Mail" I was soloing—late in 1931. Mantz gave me my time and cut me loose. Since then I've accumulated 600 hours and a straight-wing Stinson I take everywhere."

Everywhere is right. When I talked to John, he was planning a hop to San Felice, which isn't much of a town, down on the Gulf of Mexico. If the tide is out, you have a quarter of a mile wide runway and if the tide is in, you land on a plateau runway above the sleepy village. John flies in complete fishing equipment, because none is available there.

Another veteran—and one of the few Hollywood lads holding a commercial rating just for the satisfaction of it—is Lionel ("Curly") Lindon. During the day, Curly's a first assistant cameraman. His hours have come the hard way, too. You can put him down for 1,275 certified hours. With the majority, he got to working on an aviation picture and fell in love with flying. That was back in 1929.

"Chubby Gordon, a Hollywood stunt pilot, taught me to fly, and I've been at it ever since," he says.

Curly has dabbled in the business side of flying. With Charles Osborne he developed a 40 h.p. *Cub* which would fly neon signs and did pretty well at it. He also owned a "piece" of flying service at Los Angeles Municipal Airport for a while.

"But it's relaxation and recreation for me," he says. "I'm too busy supervising the cameras to monkey with the operations end. So I'm holding onto my amateur standing these days."

The development of the lightplane to where it is at the moment attracting the Hollywood rank and file to the ownership ranks. Whereas a few years ago a man learned to fly and then, because of the high price of adequate equipment, was forced to rent, he finds that ownership today is within reach of his pocketbook.

You've probably heard the name, Teddy Tetzlaff. Tetzlaff was one of the most famous of the early-day racing drivers. Before his death, he used to take his son, Teddy, Jr., out for test drives. Teddy, Jr., was in at least one rollover. He didn't like it as well as making a living with a motion picture camera, so he went into motion pictures.

"But a couple of years ago I got the longing to fly, just from talking to people," Tetzlaff says today. "I went out with a friend to Los Angeles Municipal Airport to watch him fly. I met Ted Morton and Rosa Stafford, operating the Morton Flying Service, and the next thing I knew I was taking a lesson."

Tetzlaff soloed quickly, devoted himself to getting his time in and, in January of this year, got his private license. Now he's in the market for a lightplane.

"I'm sold on the power of the lightplane jobs and on the economy of operation," he says.

Holly Morse, assistant director who also went through the Morton school, is going to buy a ship as soon as he gets his private rating. He has more than enough hours. Morse explains how he began flying:

"An assistant director has to answer a lot of telephones all day long," he says. "One day Bob Cummings took me up for a ride in his Cessna. I suddenly discovered there weren't any telephones ringing and that there wasn't a chance of hearing one. I've been flying ever since. But, sad to say, I've found that when you're working it's hard building up time. In this business it's 10 hours a day, location trips, a Sunday now and then. But I've managed to collect 50 hours in the past two years and it won't be long now. I'm going to buy a ship."

Bill Skall, Technicolor cameraman, recently bought a Luscombe. Skall flew with the Royal Air Force during the World War, and let his flying slide for a little while thereafter because of the expense. Now he's back in again, and has been for a number of years.

Earl Walcott, sound mixer at RKO studios, flew with Howard Batt on a trip to Yuma three years ago. He built up time, got his private, and now owns a Ryan STA. Douglas Shearer, head of the M-G-M sound department, still flies an Arvo *Avian* which he purchased 10 years ago.

You can thank Lars Larson, Twentieth Century-Fox air conditioning engineer for the famous Giant Rock airport, located in the heart of the Mojave Desert,

(*Continued on page 72*)

"HAVE logged 1500 hours with my three Lycomings—and not a cent for repairs," boasts a Taylorcraft operator . . . "Burns less than two and a half gallons an hour," says a Piper Cub owner of his Lycoming . . . "My Lycoming costs less than 58c an hour for gas and uses no oil between changes; it's as thrifty as a Scotchman," states an Aeronca pilot.

Such noteworthy praise clearly indicates Lycoming's thrift championship of the aviation engine industry . . . a championship as outstanding as Lycoming's smooth-as-satin flow of power, watchdog dependability, mouse-like quietness, quick-as-a-cat response to the throttle and star performance. Fly behind a Lycoming and *feel* the difference. *And save money!*

SEND FOR FREE LITERATURE: Illustrated folders on Lycoming light-plane engines may be obtained from all Taylorcraft, Piper Cub or Aeronca dealers. Or write Dept. P440, Lycoming Division, Aviation Manufacturing Corporation, Williamsport, Pa. Cable address: Aviatcor.

Illustrated is the new Lycoming *Geared* 75-horsepower engine. Other models are 50, 55 and 65-horsepower. They are all four-cylinder and air-cooled—with choice of single or dual magneto ignition.

YOU CAN RELY ON

LYCOMING

50 to 300 H.P.

Engines

FOR MILITARY AND CIVILIAN TRAINERS ★ FOR PRIVATE AND COMMERCIAL PLANES

(*Continued from page 70*)

frequent visiting spot for all southern California flyers. The field is maintained by Frank Critzer, hermit, who lives in a hollowed out rock at the edge of the field. Larson used to fly down to visit Critzer.

"Why don't you make a decent field here, Frank?" Larson asked. "You'd have a lot of callers."

Critzer fixed up the field and Larson's prediction proved true. It has become a tradition for the visitors to bring canned goods to Critzer. Often they spend week-ends in the sunny clime.

Larson has more than 600 hours. He flew before he came into motion pictures. In fact, he was a parachute jumper, with 43 leaps to his credit when he decided that air conditioning was a more healthful pastime.

Even the lads who make Mickey Mouse are interested in flying. Nick Be Tolley, Walt Disney animator, has collected 75 hours and a private license and Roy Williams, executive at the same studio, has more than 100 and a private license.

Several directors have in past years flown a great deal. Still active are Henry King, who has been flying for years and owns a Waco, and Ernest Schoedsack. The latter was taught by Bob Lusk and Marion McKeen in 1933 and has been flying ever since. He has about 300 hours.

"I got the bug when I was flown over the western front during the World War in a Salmson observation plane. We got all mixed up with Fokkers and anti-aircraft fire and I decided that flying would be swell—under more peaceful conditions."

Schoedsack recently got Winton Hoch, cameraman for Technicolor, interested. But it wasn't hard.

"I tried to get into the Army to learn to fly 12 years ago," Hoch says. "I got as far as the spin chair and I was washed out—told that I never could fly."

The spin chair has gone bye-bye. Hoch has not. He now has 65 hours, a private license and a subconscious spin chair complex. He has always wanted to get near one with an axe in his hands. It took 12 years out of his flying life—but he's making that up.

Others in Hollywood who fly include Kenneth Carter, photographic publicity man; Charlie Correll, the other half of "Amos and Andy," who really falls into the star ranks; Jimmy Moore, talent scout; Saul Wertzel, assistant director; Gustav Briegleb, who not only pilots power ships but has proved a successful glider designer and builder, and by vocation is an assistant director; Monte Robson, a re-recorder in sound; E. J. LaValle, studio electrical man; Sid Wagner, M-G-M cameraman; Bob Rhea, assistant cameraman; Bill Morrow, writer for Jack Benny and Archie Twitchell, character actor.

But that's not the full list. It's just a cross-section designed to show how Hollywood's "middle classmen" have gone, are going and will continue to go strong down through the years, flying because they love the game—not to get their names in the papers.

END

The D Ships

(*Continued from page 31*)

of competition.

The late Anthony Fokker shrewdly believed he saw a chance to make money by securing the exclusive rights to build DC's in Europe. Before he got well under way he discovered that the rights were useless, for his survey showed that planes could be manufactured in Santa Monica an delivered any place in the world for less money than they'd cost him to build.

The only pirating of design is said to be in Japan. The imitative Japanese, travellers and aviation authorities report, have built two replicas of the DC-3 and a half-size model of the DC-2. Douglas officials refuse to confirm this, although admiting "rumors." It is also an acknowledged fact that the DC's have contributed much to world aviation because many of the principles used in design and manufacture have been adopted by foreign manufacturers.

The DC's have not been content with domination of the commercial airways. With the success of the DC-2, the Army and the Navy demanded planes for transportation of officers. Moreover, bombers were needed. So the low wing was raised to mid-wing, and 170 B-18's and 170 B-18A's were constructed. Thirty more of these are on order at this writing.

The first Army transports were so well liked that the C-39 was demanded. Forty were produced. The job is notable for the fact that it has a DC-2 fuselage and DC-3 wings. Another Army cargo ship is the C-33, a DC-2 converted to such work mainly by stripping the luxurious commercial fittings from its interior.

The present DC-3, while unchanged in physical appearance during the past four years, has been refined considerably. One of the important improvements has been the constant-speed propeller. At the same time, great strides have been made in lowering vibration. Soundproofing has been a notable stride. Instruments have been improved by their manufacturers and Douglas has installed this better equipment as fast as it has been produced. Radio receivers for passengers has just been pioneered by TWA, with the pilot able to cut in and speak over the system, thus eliminating written flight reports.

Within the next two years, due to the advent for four-motored equipment on the major lines, the DC-3 will be shunted to the shorter hauls, where the DC-2 now is serving, in turn crowding out the Boeing 247-D. No longer in a position of eminence, it will lose the glory of such titles as *Mainliner, Flagship, Sky Chief,* the *Great Silver Fleet.* But long after it retires to the obscurity of an aerial junk yard or it is shunted to cargo-carrying in far-off places, it will live in the hearts of pilots flying it today. These pilots have achieved an affection for it which approaches the affection of one human for another. One said not long ago:

"There'll never be another ship like it. I've never heard anybody, anywhere, complain of it in any way."

Perhaps the greater tribute comes from an official of a rival manufacturer. He said the other day:

"I freely and frankly admit that the Douglas DC-3 is the greatest airliner ever built. There is no one connected with the manufacture of aircraft today who will not say the same thing—and that includes the heads of competitive manufacturing companies. I wish that I could say that I had had a part in designing and building it."

END

Smart Feller

COL. JOHN F. CURRY, commanding officer of the Army Air Corps base at Hamilton Field, Cal., was surprised recently by a new young soldier recruit who had been assigned to Hamilton Field shortly after joining the Army. Colonel Curry, while walking by one of the hangars, passed the new recruit. The fledgling failed to recognize the colonel and his rank in the accepted military manner. Colonel Curry stopped the boy and discussed the matter of military courtesy. After a brief lecture, the boy—very pained and surprised—pulled the day's crowning boner: "Look here now, boss, do you mean to tell me that I gotta salute every one of you fellers with the pink pants?" The recruit's education is reported to have progressed at a particularly rapid rate from that point on.

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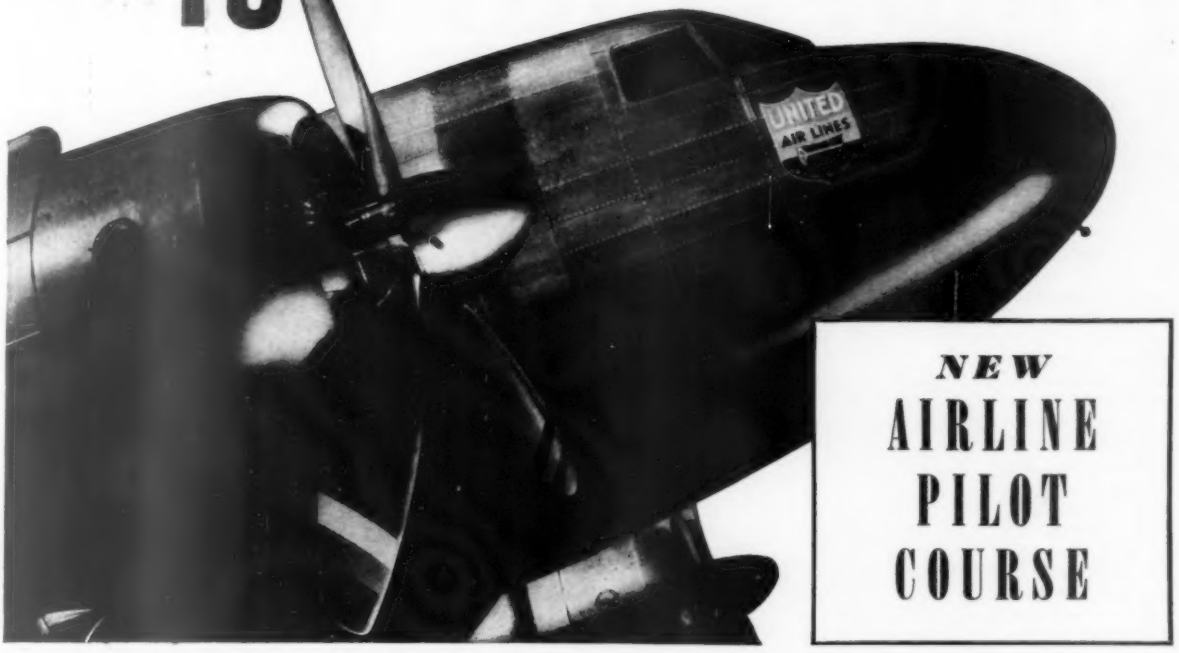

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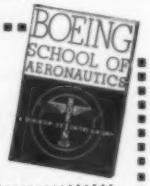

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So I Went Gliding . . .

(*Continued from page 27*)

with bolts and cotter pins. Morrison rolled out 2,000 feet of 14 gauge wire. Plenty of work for three.

The glider was now ready to fly. There was no wind, so we could take off in any direction. Harvey tied a rope to the glider end of the wire. To this rope he attached a parachute a yard in diameter which would allow the glider end of the wire to float down and reveal its position on the ground. He tucked the parachute under the venturi tube on the nose of the glider. Morrison drove the car to the far end of the wire and hitched up. He used rope to tie the wire to the tow bar on the car.

I went with Morrison. I could see Harvey getting into the glider. The Mitchells and Robinson had arrived. Robinson held the glider's wing, raising it up and down to indicate they were ready at that end. Morrison worked through three gears of the light coupe, saying:

"Watch for him to cut loose. We'll keep running until the parachute hits the ground so we won't snarl the wire." Add $5 for wire to the cost of your glider and trailer. If it breaks, you lose time patching and the new hitch may not hold. What's more, a green pilot is apt to get confused if the wire breaks when he's climbing at 15 feet per second. He has to get that nose down fast.

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Morrison's fast shift is to keep slack out of the wire. Slack is another hazard. The pilot first noses down to get speed when the wire drags. The car picks up the slack with a jerk. The wire may snap. We drive a mile. Two miles. Stephens is climbing around 15 feet a second, reaching up for 1,500 feet. Gradually the wire comes off the ground. Pretty soon we are rolling between 45 and 50 m.p.h. and the back of the car is yawing. All of the wire is in the air and Stephens is up there, a kite on the end of a string.

The car jumps ahead. That means Harvey has cut loose.

"Watch the 'chute!" Morrison orders. He keeps going until I tell him the parachut has struck the flat lake bed. Then I look up. The glider is doing lazy spirals. Harvey cruises around the lake as he slowly loses altitude. His flight lasts about eight minutes. Harvey claims he is no good on spot landings, but he sets the trim ship down within 100 feet of the coupe.

Harvey and Morrison take turns for a while. After an hour or so, Harvey looks at me and says:

"Now, you go."

"Okay," I say. Inwardly, I don't feel that way.

We go over the instruments.

"Your variometer gives you rate of climb," he says. "You ought to go up at about 10 feet a second at first. Here's your altimeter. Also bank and turn and air speed indicator. Don't let your speed fall below 35. Cut loose whenever you want to. On the left side here, painted red, is your wire release lever. Pull it out. After that, she's yours."

I get in. The hood is lowered over my head. You have to have that hood, even if it jams you down in the seat a bit. No hood means drag, a faster sink, a shorter ride. I find myself fooling with wheel and conventional rudder pedals.

"Be careful," Harvey says, "to land with the control wheel pretty well forward. Come in at a full glide. Then your load will ride on the landing wheel in the center of the keel. If you try a stall landing, as in a power plane, you'll slap down hard. You're sitting right on the keel. You have your center of gravity behind your wheel and you can't ground loop. Remember—don't stall in. Fly in."

Morrison has the coupe on the other end of the 2,000-foot wire, waiting. Harvey wags the wings to let him know we're ready. The ship rests on its wheel and the fore section of the skid. The skid scrapes as the glider picks up speed. At between 15 and 20 m.p.h. I feel the controls. At 30 I'm in the air, with no sound but the rushing of the wind. I've traveled about 150 feet. The slightest pull on the wheel sends my climb up five feet a second. A push forward and I'm leveling off, slacking the wire. Overcontrolling badly. I see-saw between level and climb awkwardly. I realize that glider controls are far more sensitive than those on power planes. The altimeter slowly climbs. I pull back on the stick and soar upward. I can see the car below. It is getting near the edge of the lake.

I see I have a thousand feet. I reach forward, jerk the red lever. There is a slight jar. I nose down as I drop my wire, so that I'll not have so much trouble picking up speed as my power leaves me and so there won't be so much of a jerk. The glider now is mine. I hold the nose down to get and hold that 35 m.p.h. air speed. At stall, Harvey has told me, the ship will mush until the nose falls forward. There is danger, as in a power plane, of a spin. Harvey has also told me to watch the vertical banks. Too steep, too sharp turns and I increase my "G" load, also inviting a spin. So I play it safe, doing a gentle 180° turn. The ship loses plenty of altitude in a bank. I level off. Maybe the sky is blue. Maybe the hills are pretty. But I don't know. I'm too busy watching that air speed indicator, that bank and turn, the slow, inevitable loss of altitude on this calm day. Oh, oh! I'm heading out over the brush toward a torn wing, a damaged "pod" or fuselage. Turns low to the ground are bad. So I pull around again, awkwardly. I envy Harvey and Morrison their neat, steep banks. Mister, this is really a shallow turn. I'm like a blind man feeling his way around a corner on a busy downtown street. Uncertain, that's all.

I straighten out. I'm getting pretty close to the ground. Up until this time, it has been something detached and unimportant. Now, however, I'm about to meet up with it. I feel that I'm going to smack into it, dig a furrow with the nose of the *Albatross*. I remember those words of Harvey—"Don't stall her in, fly her."

The ground continues lurching up at me. I ease back gently on the stick. The glide levels out and I'm skimming the ground. For perhaps a hundred yards. By this time I've forgotten there's an instrument in the ship. Too busy.

Thud! I'm down. The little ship bounces on its wheel. As it loses lift it rocks forward. The skid acts as a brake and I stop in the next 20 feet. A wing drops to the lake surface. I raise the cockpit for a breath of fresh air. Harvey comes up in the car:

"Fine! Want to go again?"

"Maybe, Harve. But first I want to think that flight over."

Watching a soaring sailplane gives one a restful feeling. It looks so simple. But actual flight means work, with something going on every second—so fast you have to hold a conference with yourself after it's over to figure out what you've done wrong.

An hour later Gustav Briegleb, glider designer, arrives with his "BG-6."

"Take a ride," he says.

So, with his friend, "Speed" Westphal, holding a wing, I do. By this time I find that I like gliding. I discover that the "BG-6" is about half way between a primary glider and a sailplane in efficiency. You can get a blueprint for a dollar or a ship, ready to fly, for $495. It has double struts with jerries for additional bracing, welded steel tube fuse-

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lage, conventional control surfaces and stick and rudder pedals.

I get in. I'm towed off. I pull the release lever at about 400 feet as I'm on a shorter tow line this time. Too low for a rank outsider to attempt a turn, so I go straight ahead, barge into an earth bank about 10 inches high and think I've wrecked the ship. But, no. It can take a pounding.

A new tow line, and I'm up 600 feet. This permits a 180° turn. One of those wide, ungraceful turns, but I make it. I land with a reasonable amount of smoothness.

I am now getting into that, "Mister, won't you please let me try it?" class. I'm running around, chiseling rides. And, before long, it's sunset. Packing is done as easily as unpacking. We pull cotter pins, stow wings, fuselage and tail surfaces on the trailer, and we're off at dusk. Harvey's ship has had about 12 flights, four with power pilots who have never glided before. The Mitchells and Robinson have been up about 14 times. The "BG-6" has been off the ground more than a dozen times with tyros trying it out. There hasn't been even a broken tow wire.

Harvey says, on the long drive home:

"That's a day in the life of a glider pilot. Anyone who has flown power planes can handle a glider. A man without any power time should have about six hours of instruction before being allowed to cut loose. We need more two-place jobs. That would cut short training time and make for better pilots."

My personal reactions:

Several flights would be necessary before I could hope to land on the average airport. I'd need hours before I could even approach spot landings. I would also need several flights before I could make smooth turns. I'd miss that motor on coming in short, as you can't stretch your glide. No power pilot with time on a glider should ever get into a stall or spin due to his feel of sensitive glider controls.

Gliding is a lot of fun, but a lot of work, as the report of this day shows. It is cheaper than power flying, but still expensive. You may not use gas in a glider, but you use plenty of gas in the car that tows you—and there is plenty of wear and tear on it, too. As recreation it's swell.

END

What, No Wedding?

OFFICIALS of United Air Lines received a shock when Stewardess Sue Nelson gave up her flying career to become a nurse in Alaska. United officials are accustomed to resignations by stewardesses leaving the service to be married. But this was practically the first time a stewardess had renounced a career in the air for a career on the ground, and an outpost hospital in the far north country of Alaska seemed a far cry from the busy New York-Chicago airway on which Miss Nelson has a flight record of 300,000 miles.

Worst to Best

(*Continued from page* 53)

flying fields circumference and they will lie within the angle covered by the heights to the west of the airport which could not, in any event, be removed. Few airports, indeed, enjoy such favorable surroundings."

Another nice arrangement is that there will be a joint control tower for the municipal field and Bolling Field, which isn't more than a mile away. Also, two of the new field's runways coincide with two at the Army base, so that if a transport were taking off and its engines quit, it could glide straight down onto Bolling. That doesn't often happen, but the arrangement's there just in case.

The Government boys have done a swell job on the arrangements for the flying field proper, but it was on the terminal (which we prefer to call the air station) that they really went to town. This magnificent pile will be another Miami air base, on a vaster scale. It will put to shame the air station at the New York municipal field. Listen, indeed, to the ecstatic description by Col. W. Sumpter Smith, chairman of the Interdepartmental Commission for the project.

"The architects of the Federal Works Administration are to be congratulated upon attainment of a truly remarkable blend of the useful and the ornamental. They have employed in this strictly functional group a treatment which in mass and line pleasantly suggests the historic character of its neighborhood.

"There is a reminiscence, rather than a repetition, of Mount Vernon on the one hand and of the classicism of the Government buildings in Washington on the other, especially in the disposition of windows and supports on the facades of the terminal building.

"They are modernistic only in the sense that they are designed to serve the needs of that most modern of all utilities, the transport airplane. Surely, neither George Washington when he designed Mount Vernon, nor the architects of the Capitol, the White House and the Federal triangle of new buildings that carry out the tradition in the creation of office buildings, envisaged the airplane and its needs. Yet, despite the primary consideration for those needs throughout Gravelly Point (site of the field), the extremely simple exterior ornamentation of the buildings provides eloquent testimony to the functional beauty of the columnar form which is the basis, after all, of the classic-colonial."

Since the Civil Aeronautics Authority is entrusted with the job of promoting civil aviation as well as providing safeguards and supervision for it, one of the primary considerations in the minds of the designers of the airport was to create an "air park" which would attract Washington residents to the field. Not necessarily to fly, but to sit around and watch the airplanes coming and go-

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ing. Along this line, Colonel Smith had this to say:

"The rest of the non-flying area is developed in a truly park-like fashion for the enjoyment of that portion of the public which likes to watch flying and in conformity with the general character of the Mount Vernon Boulevard along which it lies.

"On the shoulder of the rising ground north and west of the airport proper are terraced parking spaces in three levels, each four feet above the other and capable of accommodating 5,000 cars. Along the west edge of the flying area will be elevated benches capable of accommodating 3,000 spectators. There will be further emergency parking space for another 3,000 cars, all of which can enter and leave the airport area to and from the boulevard without crossing traffic, by means of the clover-leafed separations of grade near the north and south limits of the development."

And it only cost $9,000,000! It's colossal.

"And while the airport terminal itself provides primarily for the handling of passengers," continued the colonel, "mail and express to and from planes, its observation terraces, restaurant, coffee shop, lunch room, lounging and dressing rooms afford all of the facilities in connection with an air terminal which have proved so popular and so fruitful in the development of patronage for air transportation at such foreign air terminals as Templehof in Berlin, and Schiphol at Amsterdam, in a more compact, useful and, we believe, much more beautiful fashion. Spectators can circulate completely around the terminal building on the observation terraces without entering the building or interferring with the flow of passenger and mail traffic."

As a matter of fact, the air station does represent the best idea of the Civil Aeronautics Authority after an examination of leading airports the world over by officials of the Authority. For instance, Grant Mason and Denis Mulligan went to Europe and looked over the major airports. Later, other representatives studied the best developments on the other side of the Atlantic.

Just so that no one will think the air station was designed only for the use of the sightseeing public, let it be said that there is another floor, on the same level as the flying field, which will be a service floor. While passengers and onlookers are streaming through the upper reaches, mail, express and baggage will be handled here. The only exception to the strictly utilitarian nature of this less artistic portion of the building is a Presidential Reception Room, like that in Washington's famed Union Station, for the use of the President and distinguished guests.

Service quarters of the airlines using the airport will occupy the flying field front of the ground floor, giving them space for their flight and mechanical crews and dispatchers and the equipment needed for battery charging, refueling and other purely mechanical tasks.

No better indication of the farsightedness shown by the designers can be provided than the passenger concourse, 10 feet above the ground floor and with a terrace along the flying field and access to the traffic circle on the other side. Here is where the farsightedness comes in: it will be necessary for passengers to walk down from this level to current transports, the C.A.A. says, but with the "probable early adoption" of transport planes with tricycle landing gear, in which the doors are about 10 feet above the ground, "mobile gangways may be used for access to such planes direct from the terrace and concourse on the passenger level."

The new airport is being built to provide facilities for three airlines now serving the city: Pennsylvania-Central, Eastern and American—and no major increase in air activities in the capital is anticipated. The C.A.A.'s experts believe that the present traffic is about all Washington can expect, for many years at least. Probably for this reason, only two hangars are scheduled to be built at the present time, but plans have been made which will enable the Government to build four more without any rearrangement.

The new Washington airport really should be "the really beautiful airport of the world," as it was described to us by one of the officers of the U. S. Army's Corps of Engineers, which is doing the filling and grading. It should be an example for other cities, as is fitting of an airport which was designed by the Government agency responsible for the encouragement and protection of civil aeronautics in the United States. The chairman of the Authority summed it all up best.

"This airport was conceived as much more than a service to the nation's capital city," he said. "It was conceived as a model for what other such terminals may be. Washington, of course, was fortunate in the possession of a site capable of development so close to the city. But that very proximity imposed aesthetic obligations never before incurred in airport construction in this country.

"Not only have those aesthetic obligations been met in these plans but, we feel sure, the utilitarian necessities have been met for the present and for as far into the future as our knowledge of aeronautics can reach."

END

AOPA News

(*Continued from page* 58)

AOPA Units

The AOPA now has in operation some 114 city and airport units throughout the country. A large part of the success of this localization of AOPA effort is due to the volunteer efforts of AOPA member organizers. A new "certificated pilots extension course" is to be offered through these units at an early date. Many instances of local AOPA units having performed valuable services for their pilots and plane owners have been reported already. The National Service Headquarters in Chicago is continually cooperating with these units to assist them in their local problems and their organizational work.

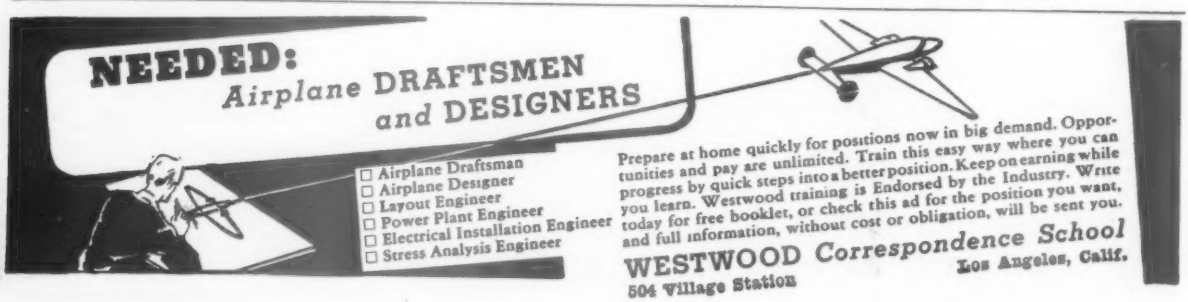
END

Some Airport!

NEW YORK CITY'S new North Beach airport, recently opened officially, has some interesting statistics connected with it. The entire airport constitutes 558 acres. Its buildings occupy 931,500 sq. ft. of floor area or a total of 36,215,564 cu. ft. There are 20 hangar doors, each weighing 25 tons; 53 acres of concrete aprons, a total of 102,100 cu. yds. of concrete and 13,000,000 bricks. Steel and reinforcing steel totaled 20,000 and 3,500 tons, respectively. There are 200 miles of cable, 400 miles of wire, 25 miles of underground piping and 3 2/3 miles of runways and taxi strips. The 25 storage tanks have a total capacity of 465,000 gallons.

Famous Ship Sold

THE twin-engined Boeing 247D in which Col. Roscoe Turner and Clyde Pangborn won second place in the famed London-to-Australia race of several years ago, recently was sold to the Air Safety Board of the Civil Aeronautics Authority. That body will use the famous ship in its business throughout the country.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Fires

(*Continued from page 39*)

before bringing the nozzle up to the filler neck.

Now that we're talking about gasoline it is well to remind you that it is liquid dynamite. The better grades of gasoline—such as the fuel ordinarily used in airplanes—is especially hazardous to handle. As it is more volatile than automobile fuel, it mixes with air in larger proportions and passes into vapor form more rapidly. Gasoline vapor is heavier than air, consequently it will float along near the ground like an invisible stream for considerable distances. The explosive mixture is between one and six per cent of gasoline vapor to the volume of air. Such a mixture if set off by a spark will expand to about six or seven times its original volume with disastrous results. An illustration of the insidious danger of gasoline is as follows: four men working in a New York City garage were killed in an explosion which came while they were cleaning grease spots off a cement floor. One man was soaking the spots with gasoline and scraping them with a hoe. The rubbing of the steel hoe against the concrete created a spark that was sufficient to cause an explosion and bring about the collapse of the building.

Another illustration: the engine of a large freighter airplane was being cleaned with a wire brush and gasoline. The wire brush rubbing against a particle of silica in the engine threw out a spark which resulted in the total loss of the airplane. It's value was $40,000.

Even when gasoline is being used in a separate room, operators must remember that gasoline vapor, being heavier than air, may flow along the ground through a crack under the door to a point where somebody is lighting a cigarette or welding or removing a battery with the likelihood of causing the fatal spark Batteries should be handled with great care because very often sparks are created when terminals are removed carelessly or the battery is negligently handled. Batteries are located behind engine compartments where there may be a concentration of oil fumes or gasoline fumes, so the chances of explosion are quite high and have resulted in serious losses.

Welding on an airplane is another source of great danger. If no welding shop is available the ship on which the welding is to be done should be moved into the open or near the open door of the hangar where it can quickly be moved into the open in case a fire starts. Some alert person should always stand beside the welder with a fire extinguisher at the ready. Fabric should be ripped a good distance back from the point to be welded and especially away from beneath that point. Hot sparks fall downwards and also drift. They are likely to alight in unbelievably far off corners. Arrangements should be made so that these sparks will not be allowed to drift to some distant point within the fuselage. The practice of surrounding and backing with asbestos and wet rags is of course to be highly recommended.

In the long run it pays to have someone stand by to attack any fire that might occur. If the man who stands by gets as much as 50 cents an hour, he could stand on guard for 2,400 hours to equal the loss of one Piper *Cub* with a value of $1,200. The history of welding fires shows that they are peculiar. For instance, there was the case of the mechanic doing some welding near the tailpost of a conventional steel tubular fuselage. All steel tubes are lined with a layer of oil to prevent corrosion within them. The oil is forced in through a little hole at the upper end of the tube. It then flows down and drains out of another hole at the tail post—in the particular airplane of which we are speaking. The heat of the welding torch ignited the oil through the hole in the tailpost. The fire burned inside the tube and was not apparent to the mechanic. Much to his astonishment a flame suddenly appeared through the hole in the center section, some 15 feet from where he was welding. It destroyed a good portion of the total fabric on the airplane before he could get it out.

As a rule, in welding operations it is fabric that catches fire. Inasmuch as fabric fires can be extinguished by water it is a good plan to have a couple of pails of water handy in addition to the usual foam fire extinguishers. Water exerts a quenching effect that differs from the smothering of fire extinguishers On fabric or wood where embers may remain to reignite the fire after a flame subsides, water should be very efficient. Water, however, never should be used if oil or gasoline is also ignited. The water merely acts as a float for this flaming liquid and spreads the fire.

One of the most frequent causes of fire losses is the unprotected extension light or drop light. The bulb is usually allowed to rest against fabric or upholstery of an airplane while a mechanic is busy with some operation and is not watching it. In a very short time sufficient heat is created to cause a flame and unless the mechanic is very much on his toes the loss is likely to be large. A very unusual fire resulted from leaving such a light turned on in a confined space. The lamp was hung so that no air circulation about it was possible. It got so hot that the waxy material that holds the glass bulb into its socket melted. The combination of a hot glass and the exposed hot filament started the fire. Luckily it was of small consequence because some one put it out before it got beyond control. All drop lights should have wire guards around the bulbs to prevent contact between the hot bulb and fabric, upholstery or anything else it might set on fire

The fire peril in hangars increases with the number of airplanes stored in them. For instance, a greater number of airplanes will attract a greater number of visitors. They increase the fire hazards associated with the added repair work. It will necessitate more frequent and longer use of extension lights and other electrical apparatus. It will mean that more ignitable material such as gasoline in tanks, doped fabric, oily rags or open cans of waste paper and other inflammable rubbish will be left in the hangar.

In crowded hangars fire will spread rapidly and destruction is likely to be more complete. The concentration of fire risks could be reduced if each airplane was stored in a hangar of its own, separated from nearby hangars by a clear space or by an adequate fire wall. A few airports do have this arrangement, but most of them have adopted the larger type of hangar, possibly for economic reasons. Strangely enough, from the point of view of fire protection, the hangar built with adequate wooden trusses (at least 4 by 4 with chamfered

(*Continued on page 82*)

Four-Engined Trainer

THE flying boat *Maia*, lower component of the Short-Mayo "pick-a-back" aircraft, has become a training ship for British pilots. She now is at the disposal of the Imperial Airways school at the Empire air base at Hythe. This school prepares junior pilots, now acting as First-Officers, for their full captaincies. *Maia* is the first flying boat in Great Britain to be used as an aerial classroom for pilots seeking their first class navigators' certificates.

Though new equipment has been installed in the flying boat for instructional purposes, *Maia* will still be available, when required, as the lower unit of the Short-Mayo composite aircraft.

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(*Continued from page 80*)

edges) may be more resistant to destruction by fire than one built with unprotected steel trusses. The reason is that the heat rising from airplane fires usually expands the steel trusses, tending to push out the walls of the hangar, and then the heat quickly softens the steel so that the trusses buckle, causing the whole roof to collapse. Wood, on the other hand, even when burning, retains its stiffness for a long time, thereby offering greater opportunity to fight the fire and to salvage airplanes.

What is more important, however, than a fire resistant hangar is good hangar housekeeping. A well-kept hangar reduces chances of loss by fire and encourages owners to store their airplanes there. By far the greater majority of fire losses are caused by simple carelessness. A loss always involves a reduction in revenue due to a lack of use of equipment, creates a bad impression in the minds of the public, usually indicates negligence on the part of the airplane owner or hangar manager and always means an increase in insurance premiums. Avoid fires.

END

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★ APRIL ISSUE ★

Popular Photography

NOW ON SALE AT ALL NEWSSTANDS AND CAMERA STORES

Doctrine

(*Continued from page 37*)

long before the population, driven solely by an instinct for self preservation, will demand the cessation of hostilities at any price, perhaps even before the mobilization of the army, or before the fleet has left its harbor."

Military men quickly raised objections. Indiscriminate attacking of civilians is against the rules of warfare and contrary to the precepts of the great commanders. The defeat of the enemy's main force should always be the objective. Further—and this is doubtless what held back Hitler's planes in the west—a bombing attack may arouse a people to a fury of resistance instead of driving them into panic.

Douhet was unshaken by these objectives. "One would indeed be childish," he said, "to permit the enemy to use for a shield women, children and old men. If you would prevent inhumanity, prevent war." In later editions of his book, he urged the abolition of auxiliary military aviation to permit the greatest concentration of strength in a terrorizing air armada. Poison gas, he argued, could be delivered easier in bombs than shells. For every ordinary high explosive bomb dropped, he proposed that three incendiary and six gas bombs be used on the same area. "Bombing should completely destroy the target aimed at," he said, "so that it will be necessary to operate only once against the same target."

When Mussolini formed his first cabinet he named Douhet commissioner of aviation. In this office the airman converted Italo Balbo and other Fascist leaders to his way of thinking and Italy was launched on a program of air development. In 1928, Balbo led 61 scout planes to Gibraltar. The next year 36 Italian bombers flew to the Black Sea. Twelve Italian seaplanes flew the South Atlantic to Brazil in 1931. Balbo led 24 seaplanes to Chicago and back two years later. In 1934, Lt. Francesco Agello flew an Italian seaplane 440 m.p.h. to shatter all speed records. Today Italy holds more aviation marks than any other nation. Italian officers say that the Douhet doctrine was "proven" in their 1931 maneuvers and in Ethiopia.

In driving the Ethiopians from Gorrahei, a battle was reported won for the first time with airplanes alone. Air attacks turned Ethiopian retreats into routs. Aviation also functioned as a medium of supply, dropping tons of food, water and munitions to the crawling ground armies. Generals and their staffs moved by air and even directed battles from aloft. Marshal Badoglio, principal leader in the campaign and a pilot himself, was rewarded by being placed in supreme command of all Italian land, sea and air forces with exactly the powers urged by the Douhet doctrine.

Douhet's ideas have also made themselves felt outside of Italy. France now has a supreme commander for all forces. All major powers, with the exception of Japan and the United States, have organized separate air forces and our new General Headquarters air force is a step in this direction. Franco favored Douhet's ideas in the Spanish civil war but never had enough planes to give them a real trial. His failure to win a quick decision is cited by opponents of the Douhet doctrine as proof of its fallacy. On the other hand, the effect of the 13 air raids on Barcelona, March 16-18, 1938, is offered by some as proof of the terrorization idea. John Langdon-Davies records that the raids by only half a dozen planes at a time "destroyed the whole mental life of a million and a half people for 40 hours."

The conquest of Poland revealed Germany as being willing and able to use Douhet methods. The swift mastery of the air, principally by the bombing of air fields, followed by the bombing of vital centers and (unless Nazi denials are to be taken seriously) the civilian population was a-la-Douhet. Some German leaders think Douhet methods can break the deadlock in the west.

A point of peculiar appeal to Germany is the fact that, if Douhet's terror has any chance for success, it is more likely to succeed against democracies where those bombarded have a voice in government. In war lord-ruled countries thousands can be blown to bits, as has been the case in China, without changing their government's course. History indicates a different possibility in England unless the Air Raid Precautions campaign teaches the citizens to endure attack. World War airplane raids on London were all conducted by a single squadron of Gothas, never more than 36 in number, but the clamor of the Londoners forced the government to keep 10 times that many planes in the vicinity. As to the moral effect, a recent history edited by Major General Sir Ernest Swinton says:

"Not even in the Napoleonic era had the whole country been made to feel such a sense of all but total helplessness. Nothing could show more clearly the psychological value of this new weapon of war. . . .

"On Sept. 24, 1917, it was estimated that some 100,000 people had sought shelter in the underground railway stations. As the raids went on unchecked, the desire to leave the threatened districts of London grew apace. Every night the main-line stations were besieged by crowds who sought the open country, where they hoped to find a night's respite from the tension of the raids."

Threats of recreating this conditon on a vast scale enabled Hitler to blackmail his way through Europe for two years. Just how far he is prepared to go with the ideas of Douhet, only the high Nazis know. To cut loose with all of their planes would be a greater gamble than they have yet taken. There is always the possibility that the threat of planes may be more profitable than their actual use.

Douhet did not live to see his ideas developed. A heart attack killed him at Ceschina, near Rome, on Feb. 15, 1930. But death did not stop his arguments for air power. He left behind a manuscript titled, "The War of 19..," published posthumously by *Revista Aeronautica*, the magazine of the Italian Air Ministry. This was the imaginary account of a one-day war in which a force of 1,500 German planes of the flying fortress type detroyed the more numerous but less efficient air fleets of France and Belgium. The

(*Continued on page 84*)

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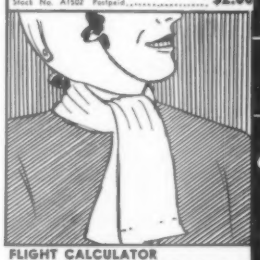

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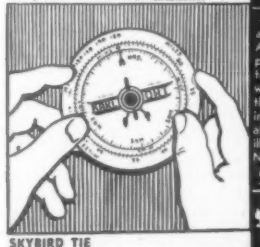

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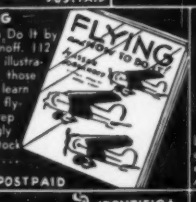

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(*Continued from page* 82)

German craft attacked in eight columns of three to nine waves of planes. All of the first waves were shot down in what Douhet called "The Battle of June 16" but by night all the French were out of the sky, Namur, Soissons, Chalons and Troyes were shambles and the government sued for peace.

The air armada which Douhet visualized as accomplishing this triumph was composed of self-protecting, fast, armored bombers of a single type but of three degrees of power. The force of 1,500 was described as of 800 planes with engines totaling 2,000 h.p. each; 600 planes of 3,000 h.p. and 100 planes of 6,000 h.p. There are few planes of the last class in the world today but plenty of power equal or greater than the other 1,400 planes of Douhet's mythical force.

Germany has the Heinkel and Dornier bombers. From Italy she might obtain Capronis and Savoia-Marchettis. Russia has a few monster craft. But of equal power and able to retaliate swiftly for anything accomplished by them, are the Handley Pages, Armstrong-Whitworths, Boeings and Martins available to the democratic powers.

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★ MAY ISSUE ★

POPULAR AVIATION

ON SALE AT ALL NEWS-STANDS APRIL TENTH!

It is too late to gain the surprise advantages of the Douhet doctrine but, if and when the air forces go over for a final showdown, the outcome will determine whether history will record Douhet as a murderous dreamer or, in the words of General Balbo, as "the first in all the world to have forecast the fundamental importance of aviation in the wars of the future."

END

Warbird Depot

(*Continued from page* 45)

ness tester. Outside the entrance to the foundry is a refrigerator where rivets are kept on ice.

A large space is given over to the "engine pool" where the motors, brought in from the field, are left for overhaul, awaiting a trip through the cleaning tanks. Among other departments are those for cleaning and sandblasting, the engine paint section and the cylinder and valve rocker arm section. We walked along the engine sub-assembly group for rods, crankshafts, piston rings, manifolds and push rod housings. Then came the assembly section. After the engine leaves the assembly division, it goes to a test block and is run for an average of from five to seven hours. It then is rechecked and inspected and made ready for installation. The test block handles engines up to 3,000 horsepower. Incidentally, the Army figures on a year and a half to take the "bugs" out of new engines so they will suit military engineers.

There are 52-ton overhead cranes that carry five tons and are controlled by a five-control speed. They can travel through the entire building when the doors are up. The doors themselves weight 35 tons each, but are easily handled by the mere touch of a button. The building is warmed by numerous gas heaters and five 30 h.p. gas furnaces furnish the steam necessary for cleaning.

Although accidents are at a minimum, there is a nurse on duty all the time in the first aid room. But first aid isn't necessary for "glass cuts" in the Plexiglass department, for this material does not splinter. This composition is put in an oven, heated to 230°. It is then molded under pressure into plane windshields and cockpit covers.

When the writer went through the engineering department, mechanics were working on about $1,000,000 worth of motors and the value of planes and equipment under repair totaled nearly $2,000,000.

Experts agree that there is no finer aircraft repair base in the country. The Sacramento depot is the supply center for all the Army Air Corps in the western part of the United States as well as Alaska, Panama Canal Zone, Hawaii and the Philippine Islands.

To see that this area has an adequate reserve, the depot supply building covers nine acres and there contains 45,000 articles. These run from complete airplanes to waste baskets; from parachutes to stationery. Its 14 warehouses have room for storage, packing, weighing and shipping of supplies, flying clothes, parts and even film. The office building also contains kitchen, cafeteria, and recreation room for civilian employees. The construction is of structural steel columns and trusses with wood deck and built up roof and concrete walls for supply section and reinforced concrete and built up roof for office section. The cost of this unit was approximately $1,000,000.

Set apart from the other building area to reduce effect of the noise of motors, is the engineering test building. Here engines are "run in" and tested after overhaul. The building is soundproofed and is thought to be one of three buildings of its kind in the United States. It cost nearly $220,000.

Further idea of the size of the depot may be gauged by the fact that it has a 300,000-gallon water tank, the quartermaster's buildings cost over $100,000, there are two miles of standard gauge railroad track on the grounds, a 100,000 gallon gasoline storage system and $35,000 worth of landscaping shrubs on the grounds or in the nursery. The cost of supplying water runs close to $80,000 and the sewerage system cost $55,000. Lighting of the reservation cast $60,000 and even the fire alarm system cost $5,000.

The air depot is truly a city in itself with a $130,000 dormitory—reinforced confrete and fireproof—that holds 132 men and the two-story building is said to be the finest barracks in the country. Another dormitory—for the 7th Transport Squadron—will soon be constructed. When mess call sounds the men eat in a hall that is similar to a modern cafeteria. After dinner, they can go to a recreation hall with easy chairs, magazines, a pool table and a radio.

An example of how the officers are quartered is Colonel Kennedy's home, which cost over $15,000. There are five bedrooms and two bathrooms on the upper floor of the confrete house. On the first floor are a kitchen, dining room, living room, bathroom and servants' quarters. There is a two-car garage and the house—because Sacramento has been known to be a trifle warm in the summer time—is partially air conditioned.

Other officers' houses on the depot include five costing $14,500 each, for men who rank as major or above and numerous other houses for commissioned and non-commissioned officers ranging in cost from $8,000 to $12,500. Modern bachelor apartments are provided for the unmarried officers.

The new depot is not the first important base at the city. In 1917 an Air Corps training field was established at Sacramento but, after the close of the World War, the field was inactive. Several years later the field was renovated and, by 1930, the Army had stationed 700 men there. But this proved a temporary move.

Then the turn of affairs came on the west coast when the Army decided to give Rockwell Field at San Diego to the Navy and the Sacramento Chamber

(*Continued on page* 86)

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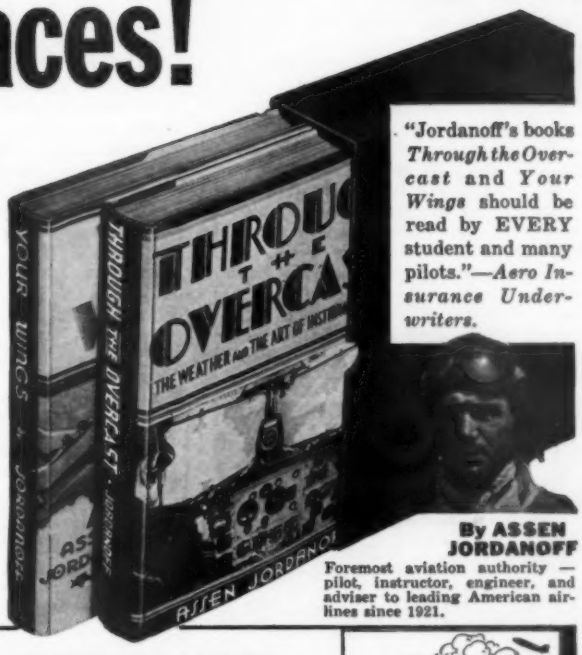

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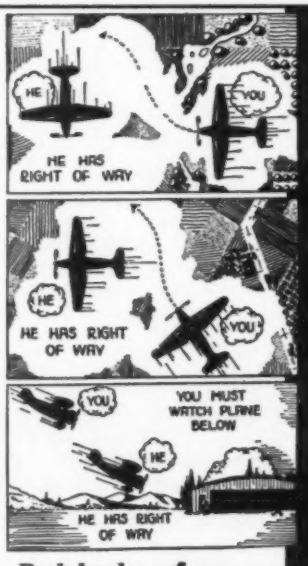

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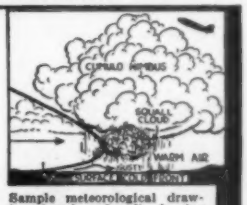

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(*Continued from page* 84)

of Commerce, through its connection with the National Air Frontier Defense Association, was asked to secure options on 1,200 acres of land as the city had been selected for the new supply and repair depot.

Bespectacled Arthur S. Dudley, secretary and manager of the Chamber of Commerce, is one of the men happiest over the coming of the depot. "Mather Field (the old training base)" he said, "was reserved as a possible future base. The reasons Sacramento was selected for air defense operations are many. It is 70 miles from the ocean and is on paved boulevards, railroads and airways which radiate in all directions. Because of the central location, transport planes from the depot can with the greatest efficiency supply other air fields. Also dockage accommodations on the Sacramento River are well related to the field. The new large bombers could not be transported over ground where there are underpasses or railroad bridges and the base is situated so there is no interference of this kind."

Commanding officer at the depot is Col. Frank M. Kennedy, who came to Sacramento when Colonel Strauss went to the Canal Zone. Executive Officer is Maj. Fred C. Nelson. Stationed at the depot are the 4th and 7th Transport Squadrons. The 4th, commanded by Lieut. Lloyd L. Sailor, was transferred to Sacramento from Rockwell Field. The 7th, commanded by Lieut. Thomas S. Algert, is a new squadron that has come about with the recent Air Corps expansion. These squadrons, made up of 32 officer-pilots and three warrant officer-pilots, and about 100 enlisted men, carry supplies to and from Army Air Corps units and other vital points, such as plane factories and training schools. They also fly intra-depot freight that takes the flyers from coast to coast. The pilots have cut the transportation time of supplies from the Atlantic coast to the Pacific from five months by water to less than two days by air.

END

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Thoughts on War

(*Continued from page* 19)

view. The fuel tank behind the pilot fitted perfectly into the scheme of the drawing board designer, hard at work considering such problems as the location of the center of gravity and the travel of the center of pressure on the wing.

Good design means many things. It means speed, maneuverability and provision for adequate fire power. It means ease of control at critical moments. It means stability. It means all the protection possible for the pilot and, in the case of larger aircraft, of his crew. It means an airplane built by compromise between the need for a highly efficient weapon and the need for an aircraft of aerodynamic perfection.

Design caused the backing and filling of air superiority in the first World War. That British commander-in-chief who hastily advised the war office that better pursuits must be made available or the war might well be lost had been brought up against a German pursuit of new design. The tide of battle in the air swept back and forth almost with the regularity of a clock's pendulum as men with slide rules and blueprint paper turned out the Albatross, the Roland, the Nieuport, the Spad and the Fokker. Fighting planes all, because in the fighting plane rested the gauge of air superiority.

It was the fighting plane which, in those mad days of 1917, when Czarist Russia was gambling desperately against the necessity for making a separate, dishonorable peace, enabled us in the Russian air force to strike telling blows from the air in quick raids over the Gulf of Riga. Our pursuits paced the bombers, sweeping clear the path on which they sped to drop their explosives. Credit to French engineers, those pursuits were Russian-made Nieuports and Spads. Our bombers were flying boats designed by Dmitri Grigorovich — recently recalled to the drafting board, by the way, by the Soviet government after a long period of inactivity—to turn out pursuits.

The convictions I gained in the first World War were embodied, of course, in the designs of the airplanes I later built in the United States. I believed, and events in the new war would seem to bear me out, that fighters need not only speed and maneuverability but range as well. It is a natural source of satisfaction that a long-range Seversky holds the current east-west transcontinental record of 10 hours, three minutes, and that other Seversky's won the Bendix race three years in succession. Before engines attained their present tremendous power, I was so interested in extending the range of military planes that I contrived a refueling system which was the basis of extended experiments by the United States Army Air Corps.

Now it is interesting to watch the efforts being made by the European belligerents to extend the range of their pursuits. Their "interceptors" (a misnomer, because their mission is to intercept the enemy at a considerable distance from their own bases, not immediately above the enemy's objective) lack the staying power necessary for the job to which they are assigned. Their local fighters can well be designed to come to grips for a brief 30 minutes or so in the great air space over the public utility plants or munitions factories which they seek to defend. But their interceptors must be provided with a second wind and only now are the nations at grips with each other giving their fighters in that category a chance to show their worth. The Messerschmitts, the *Spitfires*, the *Hurricanes*, the Dewoitines, the Moranes and the Koolhovens are being redesigned in the struggle for air superiority. The Germans are pushing the production of a new Heinkel and of the two-engine Messerschmitt Me-110. One of the new Messerschmitts recently cruised over London, ample fuel in its tanks to return to its base. It was a novel sight for Londoners, accustomed to air raid alarms with the approach of enemy bombers.

What the Germans will do with their two-engined fighter remains for determination as the war wears on. But I believe that the British fighters, given added fuel capacity, will be of material help in England's fight for air superiority. It was my good fortune to spend a month at Martlesham Heath, the Royal Air Force testing station, last summer. The government was kind enough to make an exception in my behalf and I was the only foreigner to fly a British military plane. After viewing a good many other pursuits, I concluded that the *Spitfire* was the best all-around fighter actually in service.

It does not have the easy accessibility for maintenance that the Messerschmitt has, and the Rolls Royce engine loads up in inverted flight. With its fuel-injection engine, of course, the Messerschmitt performs perfectly in any flight attitude.

On an hour's test flight I discovered

(*Continued on page* 88)

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that beyond 280 m.p.h. the *Spitfire's* ailerons grew so tight as to require both hands to move them. I had experienced the same trouble in designing the Seversky P-35, and I made some suggestions to the testing station for correcting the trouble.

Flying under an unusual overcast of 18,000 feet, I put the *Spitfire* through the maneuvers which would bring out its qualities. With no constant-speed propeller, the plane was sluggish—and, incidentally, very blind—on the take-off. But as it gathered speed its climb was very good. The visibility was excellent in the air except for a slight distortion of vision due to the rounded plastic windshield. I took a rough calibration of the air speed and arrived at a pace of 362 m.p.h. at 16,000 feet. I am sure that a few more miles an hour can be obtained from it. In the slow rolls, snap rolls and loops the carburetor flooded badly and it took some time for the engine to recover.

The plane behaved nicely in two pull-outs of seven Gs, though it did not feel as rigid as American planes with monocoque structures. It was stable at stalling speeds and landed perfectly. However, due to its small flap area and cleanliness of design, it has a very shallow glide which precludes landing on any small field with high obstructions.

Predictions in this world of surprises, and particularly in wartime, are always dangerous. But I should like to hazard the opinion that as the European holocaust wears on, fast, long-range pursuits will be the only types of military airplanes able to remain in the air during the daylight hours. In the first World War pursuits came to be used not only for fighting, but also for photographic work and scouting. Other types, too slow for the vicious in-fighting which became an every day occurrence, simply were obliterated.

I believe that bombardment aviation, in this war, will confine its operations to the night hours or to bad weather conditions—except, I hasten to qualify, in the event of a decision by one side or the other to stake all on a tremendous air defensive, an effort to end the conflict with one blow.

One of the high commands may convince itself that such a game would be worth the candle.

END

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Book Bug

(*Continued from page* 68)

York City and return:

St. Louis—Found a copy of "The Langley Memoir on Mechanical Flight" by Samuel Pierpont Langley, edited by Charles M. Manly, published in 1911 by the Smithsonian Institute—*cost only $4.*

Chicago—Bought copy of program of first Chicago air race meet, held in Grant Park in 1911.

New York—Bought 1910 to 1919 file of "Aeronautics" magazine, bound files of British magazine "Flight" and French "Annunaire de L'Aeronautique," also file of World War I issues of "L'Aerophile." Went broke, but ordered quantity of virtually antique French and German publications listed by G. E. Stechert & Co., importers. Arranged credit. Ordered quantity of up-to-minute German Luftwaffe material.

Visited private library of William Burden, noted New York collector. Found Burden wanted 1917-18 file of the Curtiss "Fly Leaf" (first Curtiss house organ) to complete his collection. Had duplicate "Fly Leaf" file at home, so traded enthusiastically with Burden.

Visited Institute of Aeronautical Sciences library. Traded extensively. Acquired complete NACA bibliography and rare foreign aviation catalogues. (Author's note: Robischon also mentions casually that he "saw a lot of scenery and the National Air Races at Cleveland." Actually, he saw the races as a member of the crew of one of the race pilots—hard, dirty work.)

Back home and cataloguing his newest finds, Robischon has formulated a definite program. He has resolved that his library must become a research facility for the nation. He has made a small beginning. He is charging nominal fees for commercial research and using the funds to enlarge his library. Veterans of the aviation industry, owning memorabilia of their early days, are beginning to entrust such items to Robischon, knowing that they'll have a lasting guardianship.

Yet the Robischon library is no "mustn't touch" sort of place. On the contrary, its owner has made it a custom to remain at home each Monday, Tuesday and Wednesday evening to welcome anyone who comes for information—or just to chat. No one is more pleased than Robischon when his shelves provide a student with material for a thesis, or clear up an obscurity for a researcher.

"This library is for the widest possible use, make no mistake about that," he pledges. "But my ambition goes much deeper. Aviation is young in years but old in progress as a science. This progress must be documented, every phase of it. Here is my dream:

"To establish a national facility for aviation research, a place where accumulated knowledge may be collected and catalogued efficiently, where all comers will find accurate information on the evolution of flight by man.

"I want to do this myself. I don't want formal endowment because it might be too restrictive. You see, I dream of a library where men can smoke . . . sit around and do hangar flying . . . dig for data in an easy atmosphere, not in the cold, formal, musty air of a dowdy library.

"This may sound visionary, but—well, I've a lifetime ahead of me to try!"

END

Battleships

(*Continued from page* 12)

ceptable twin-engined fighters. They would have to be provided with supercharged engines for high altitude work, of course, instead of power plants rated for low altitude flight as in attack flying. Perhaps this will be done, either in France or in the United States.

To the French goes the honor of first resurrecting the twin-engined fighter in Europe. The graceful Potez "63," now relegated to reconnaissance duties only, was the first of the "modern era" (at least one unsuccessful English twin-engined fighter was built about ten years ago, but it could hardly get off the ground and was simply given up as a bad job). The Potez had a pair of Hispano-Suiza radials and a maximum speed of 265 m.p.h. when it first appeared. Now Pratt and

Whitney *Twin Wasp Juniors* are being fitted and maximum speed is 285 m.p.h., still too slow for fighting. England's twin-engined fighting mainstay at the moment is a converted Bristol *Blenheim* bomber (despite the impression to the contrary given by official announcements and the newspapers). The *Blenheim* is small as bombers go (span only 56 feet and gross weight barely over six tons) and in the long-nosed version, fairly fast: 295 m.p.h. So it is acceptable for the present, although six months from now it will have to be retired to not-so-tough assignments and replaced in the tight spots by better machines undoubtedly on the way.

One twin-engined Fokker machine, the G-1, which carries eight rifle-calibre machine guns or two 20 mm. cannon and two machine guns, is in the same class as the twin-engined fighters the belligerents are putting into service, although it is a little slower than the best of the others. A possible explanation is its relatively low-powered engines (Bristol *Mercurys* of about 850 h.p.—but Fokker cannot afford to put the very highest-powered engines available in most of his machines. In the first place most of them are produced by powers now belligerents and are reserved for their own craft. In the second place, a Dutch company has to sell its equipment on a straight commercial basis and has to keep the price down. The Fokker firm does not have a powerful government buying up as many planes as can be produced and coming back for more.

Biggest of the multi-seaters is actually the Bell XMF-1, which carries a crew of five, grosses nearly nine tons, has a top speed of not quite 350 m.p.h. (according to the pessimists) and carries besides four machine guns, two of those colossal 400-pound cannon.

The multi-engine multi-seaters form one of the two distinct, most popular lines of development of fighting craft, the single-engined single-seater being the other. They are not, by the way, *"multiplaces de combat"* as some insist. The *multiplace de combat* was an unsuccessful idea. The bomber which covered every possible approach with one or two machine guns, spread itself out everywhere and as a result did not have victorious fire power anywhere—and the multi-seat fighter is definitely unsuccessful.

Equally interesting are two single-seat twin-engined planes, each markedly different from the other. One, of course, is the Lockheed P-38 in which Lt. Ben Kelsey "loafed" across the continent on 60 per cent throttle at 356 m.p.h. a year ago, with sundry inadvertent adventures en route. Such as the consternation at Pittsburgh when, out of the blue, a plane overhead radioed that its airspeed was 397 m.p.h. (this and the control towerman's expressions of surprise were broadcast over the public address system). One of the chief things for which the Lockheed is reputedly remarkable is a good deal of automatic equipment to enable a man to fly a twin-engined machine and still have time and energy to fight.

The other is one of the last planes Tony Fokker had a hand in designing before he died, the D-23. The engines, in-line power plants of medium power, are arranged in

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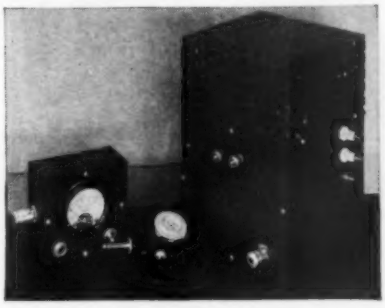

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tandem instead of in twin—one in front of the pilot and the other, driving a pusher propeller, behind him. Armament is two 20 mm. cannon, mounted at the forward ends of the two tail booms which run back from the wings outboard of the fuselage and which carry the stabilizer and elevators between them (thus allowing space for the pusher propeller). Just how good this unusual design is, no one will know until it gets into a war—not likely at the moment unless the Germans move in on Holland—but like so many other Fokker novelties, this one too may upset the conventional applecart.

Fighter development is also proceeding somewhat more slowly along other lines to fit specialized needs. One such is the single-engined two-seater fighter. As I recall at this distance, the last fighter of this type in the U. S. Army Air Corps was the Consolidated P-30, which probably is entirely out of service by this time, though a few may be lingering. England, however, has two types in production—the Boulton Paul *Defiant* for operation from land bases, and a slightly smaller ship, the Blackburn *Roc,* for aircraft carriers. The chief feature of both is the use of the Boulton Paul power-driven turret, which can carry and move several guns. The idea underlying the development of the two craft is that the plane shall cruise along side an enemy bomber and simply pour a broadside into it. To get the turret (which must weigh in the neighborhood of 400 or 500 pounds without guns, ammunition or sights) and the second man in, a larger machine had to be built and since it is powered by only a single engine, a considerable amount of speed must have been sacrificed. The *Defiants* have not been in action yet, but when they finally appear they undoubtedly will bear watching.

Another specialized type under consideration is a single-engined long-ranged fighter for escort work. No new ones are under construction, so far as is known, but they might be similar to the Seversky convoy fighter or one version of Germany's famous Heinkel He-112. The beauty of the twin-engined fighter, however, is that it can carry out all these specialized jobs in what is basically the same airplane. Me-110s are doing escort work and others can and will as well. The twin-engined fighter can carry out ground attack with fragmentation bombs or machine guns. It can climb high and rapidly, overhaul attacking bombers and can tear them apart with its superior armament. Since they will generally be smaller and cleaner than the bomber, they will always have the necessary margin of speed. They are certainly better fitted than single-engined single-seaters by virtue of their greater fire power for action against enemy fighters. The pocket battleships of the air will be heard from on all these counts in days to come.

END

Flight Surgeon

(*Continued from page* 42)

doctor once a month. Department officials not only granted the permission but complimented the company on its pioneering foresight.

So well did this experiment work out that Dr. Louis L. Bauer, then medical director of the aeronautics branch of the Department of Commerce, urged all air transport companies to maintain their own flight surgeons to insure the physical fitness of their pilots.

"Physical fitness," Dr. Bauer said, "is more important in aviation than in any other walk of life. A pilot who is under par physically soon becomes a prey to aeroneurosis. He will dislike to take the air and may actually fear to leave the ground. Sometimes he will admit this fear; more often he will not. But if he leaves the ground with this feeling, he becomes dangerous to public safety."

Since that time, a vast although scattered corps of especially trained physicians has been studying the problem and working out new methods and techniques. Information has been exchanged and records have been assembled and as fast as evidence accumulates, operators and pilots have been warned of possible physical or mental dangers.

The typical airline medical department of today is by no means a small "one man" office although the flight surgeon is still the dominating figure. One of the most-up-to-date of airline medical centers is that maintained by United Air Lines at its Chicago headquarters. This comprises nine separate departments, one each for eye testing, ear testing, nose and throat testing, X-ray and fluoroscope diagnostic work and so forth. There are general examining rooms for men and women, a basal metabolism room and a number of test laboratories. Equipment valued at over $20,000—including complete X-ray and fluoroscope devices, an electric cardiograph, a basal metabolism apparatus and all the latest eye-testing devices—are in daily use. The department was established by Colonel A. D. Tuttle, M.D., U. S. Army (Retired), who for four years was commandant of the Army's School of Aviation Medicine at Randolph Field. From five to ten especially-trained surgeons are regularly employed in its laboratories.

American, Eastern and Pan American Airways also have elaborate medical setups, requiring the services of from two to five full-time men each. Most of the other commercial companies rely upon part-time medical workers scattered about in various sections of the country. The earnings of the doctors regularly employed as flight surgeons run, on an average, just a little above those of surgeons in general practice. The part-time air doctors are paid on a fee basis.

About 700 doctors with varying degrees of special training in aviation medicine, are designated as authorized medical examiners by the Civil Aeronautics Authority. Their job is to give each applicant for a student pilot's license a thorough physical examination, recommending those who pass to the C.A.A.'s

medical officer, who issues the license. This license specifies the highest grade of pilot license the applicant's physical qualifications will permit him eventually to obtain, according to the results of the physical examination. These physicians are allowed to charge a standard fee of $6 per examination.

In addition, there are about 50 graduates of the Army's School of Aviation Medicine on active duty with the nation's armed forces—Army, Navy and Marine Corps—stationed wherever there are concentrations of service planes and pilots. These are paid, of course, according to their rank and station.

The most noticeable development to date resulting from the work of all these flight surgeons has been a marked decrease in the working hours of commercial pilots. Today most of them fly no more than four hours per day and have at least one day's rest in three. Vacations at frequent intervals are insisted upon. Any hint of worry or fatigue makes the pilot immediate subject for concern.

Also notable is the marked decrease in the number of airline accidents attributable to personnel failure. One would have to look many years into the past to find the record of a mishap caused by the illness or the "staleness" of an airline pilot.

"Grounding" a trained pilot is a serious and expensive business and all the lines seek to avoid it for professional and personal reasons. But it simply is not good business to let a man fly when he is in a physical or mental funk. However, the flight surgeon's most difficult task usually is that of forcing the retirement of a veteran flyer who has seen years of service but whose facilities are gradually going back on him. Today, some of the best men in the transport service are 40 or more, with long service records dating back to World War days. Their experience now ranks them ahead of the younger men with better training and quicker reactions, but it cannot continue to do so indefinitely. And so it is that sooner or later the flyer, whose first real contact with his chosen profession was in the office of the doctor who pronounced him physically fit for service in the air, must eventually return to a physician's office and be told that he is no longer fit for the hard work and terrific nervous strain of airline service.

In all, the flight surgeon's job is a difficult, heart-breaking one, for his "turn-downs" always are far greater than his "O.K.'s." Nevertheless, it is a task that has its compensations, Safety in the air, for pilot, crew and passengers alike, is its objective. And for this, no sacrifice should be too great.

END

Busy Airline

UNITED Air Lines recently completed its 150,000th mile of scheduled flying. That includes approximately 32,000 coast-to-coast flights. Nearly 68,000,000 miles of the total were flown at night.

Family Airplane

(*Continued from page 26*)

and then turn on electric current and do a mass spot welding job. Over that could be fitted the trailing half of the wing cover. Our ribs, instead of being of flat sheet type with cross bracing could just as well be of channel type, which is far simpler and more practical. Mass production of transports has gone far in effecting simplification, but we can go much farther in a very short time—and we are.

We have come to the point of exploding another bugaboo. Mass production seems to be synonymous in the public mind with the elimination of practically all manufacturing costs. This is not true. Even in mass production we have to have labor and the amount of material used in each unit remains the same. And, to top this, we have to charge off to each unit the expense of tooling our vast factory. The savings of mass production will be considerable but not great enough to supply that mythical $700 airplane.

Before I give you the bad news, let's consider the cost of the motor I have described. This should cost from $1,250 to $1,750 on a mass basis. That sounds like a lot of money until you consider that today's standard 400 h.p. radial costs $5,000. Remember, too, that

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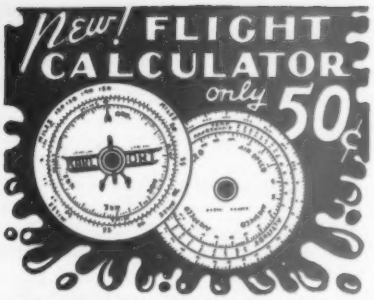

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whether you make a few or many, the motor calls for the finest workmanship and materials available.

I would set the cost of the motor at from one-quarter to one-third of the entire ship, which makes our total cost about $5,000, I hope a little under. I would not be satisfied to design a family airplane for less. This is twice the cost of a fine motor car. No doubt you are shocked. But even with mass production, it is impossible to get the figure lower and use adequate materials. Today's ships capable of the performance I have outlined cost from $10,000 to $25,000 and up.

What of models? There will be but one model. There will not be, for instance, one which will cost $5,000 and carry five people, and one which will cost $2,000 and carry two people. For, figuring on a mass production basis, complete tooling would be necessary for each model. It would simply be another airplane. The problem wouldn't be as simple as it is in the automotive industry, where a standard chassis carries all body types. There will be nothing to choose from. You will take it or leave it.

I guarantee that in this airplane of mine you will get dollar for dollar value in comparison with the mass-production motor car. But there will be more dollars involved in manufacture, therfore the cost will be more. As to market, I think there will be plenty. There are thousands of automobiles in the United States which cost $5,000 or more; thousands of homes which cost $10,000 to a great deal more; thousands of yachts of all descriptions costing $5,000 or more. The thing America has needed is an interest in flying born of association with it and experience in it. America is getting it today and this is the basis for the success of my family plane.

Now, all I need is a manufacturer who is willing to gamble with me.

END

Cubs' Den

(*Continued from page* 17)

private rating and his 18-year-old daughter, Betty, is a student pilot. Piper also has gotten a few more pilots in the family.

"The girls my boys married," he explained, hopefully, "have soloed."

Despite his 59 years, Piper retains excellent vitality and boundless enthusiasm. If Bill Piper has a particular aim in life, it is to reduce flying costs. He has ruthlessly slashed the prices of his planes until competitors predicted ruin, but Piper has gone on confidently.

"And, by golly," he insists emphatically, "they're still too blamed expensive. We've got to get up enough production so we can cut them still more."

His particular hate is the airport which charges $25 to $35 a month for storage of a *Cub* or other light airplane.

"Outrageous," he storms, and proudly points out his row of neat little hangars at the factory, emphasizing that such hangars can be rented out at $3 a month at a profit to the owner.

Piper encourages his own employees to fly and the sleepy little town nestled among the high hills of central Pennsylvania is rapidly becoming one of America's most air-minded towns. Virtually everyone in the town has flown at some time or other. Piper frequently sponsors free flights, at which time 1,100 to 1,200 persons are taken up for rides in a single day. About one-third of the factory's employees already are pilots. Many others are rapidly becoming pilots, getting instruction from a factory pilot for only $1 an hour.

Flying at the factory really is safe. The *Cub Flyers* flew 3,270 hours in a 12-month period—a distance nearly equal to 11 times around the world. A check of their automobile speedometers showed that club members had driven only two-thirds that distance. Accidents? Well, members have had three automobile accidents—but none with planes.

Piper doesn't believe in excessive regulation.

"We aren't going to get any place," he said, "unless we get a more simplified system of regulation." He blames most of the air accidents on pilots with a certain handicap: lack of brains.

"Lack of brains," Piper insists, "is a worse handicap than lack of an eye, arm or leg. We've got a lot of pilots with such physical handicaps who are good, safe pilots—but I've never seen one yet with a lack of brains who was a good, safe pilot. But then such a pilot isn't a good, safe automobile driver or a safe man at a factory machine or at anything else."

Piper is particularly jealous of his planes' reputation for safety and strength. He is proud of the work his ships are doing in various parts of the world. For instance; they're used for photographic work, pilot-training and running errands. One *Cub Coupe* owner, Clinton Shirley of Fort Worth, Tex., is a professional livestock surveyor. He uses his ship to fly over a herd, studies the cattle without landing and flies back to report to his client on the value of the herd. Another *Cub* owner uses his ship to haul gold from an inaccessible gold mine to civilization, using a tiny field at the mine which would be impossible for another type of plane.

Piper has great hope for the future of lightplanes. So has the Civil Aeronautics Authority. Neither will concede that there is a saturation point for lightplane sales. Both talk about licensing 50,000 planes in the next five years. Meanwhile, Piper is doing his bit to lower plane costs still more and to prepare for greater mass production. Already his factory, more than any other, resembles an automobile factory with its production line methods. The factory buys its supplies—Northwestern spruce for wing spars, steel tubing for fuselages, alloy for wing ribs, air wheels and fabric—in carload lots. The factory is plentifully supplied with expensive machinery.

"That," says Piper, "helps keep costs down. Machines cost plenty of money, but they do a lot of work rapidly."

Tubing is cut for 200 airplanes at once and is stacked in racks. Each part is

(*Continued on page* 94)

Airy Chat

(*Continued from page 4*)

expressed such interest in the articles we'll probably be running them five years from now. We're well on the way, at least. Coming up soon are Marshall Headle, Lockheed's chief test pilot; Cloyd Clevenger, veteran free-lancer; and Earl H. Robinson, another of the movie stunt pilots.

* * *

FUNNY so many communities are indifferent to the need for air markers. Perhaps it's just that city officials have no conception of the value of an air marker. We'll never forget the one time ours and two other lives were saved by one. We were scooting over the tops of densely wooded hills deep in Pennsylvania. Our old biplane's three gas tanks all had sprung leaks and were down to about a pint. Solid overcast forced us lower and lower. It was just about dark, raining and we were completely lost. No parachutes, either. The clouds came lower and we soon were flying up and down narrow valleys looking for any tiny clearing. The pilot shook his head and pointed to the tree tops, indicating he was going to try mushing into them so as to hurt us as little as possible. Suddenly, as we flew over a high hill we all yelled at once: an air marker! Whitewashed stones on a hillside formed the word "Clearfield." Out came our map, we located Clearfield, found the nearest emergency field and got to it just as darkness, the weather and our ship settled onto the ground. That air marker, we were told, was the work of the Clearfield, Pa., Boy Scouts. This is the first chance we've had to thank them.

* * *

NOTICED an old trick the other day we hadn't seen in aviation for a long time. A manufacturer announced a new low-wing monoplane, ostensibly ready to go on the market. With his announcement the manufacturer sent along a photograph of "the first of the new ships." Actually, the photograph was of a small scale model placed on the apron of an airport and photographed at such an angle that the model looked life size. We were surprised by the number of folks in the industry who thought it was a picture of a completed airplane. Actually, to the best of our knowledge, no full-sized airplane of this design exists.

* * *

THE post card from Bob Winston the other day was a surprise. He mailed it just before sailing for Sweden, accompanying those Brewster fighters recently sold to the Finns. Says he's to teach the Finns how to handle them Bob, you'll remember, wrote several articles for us, based on his experiences as a Naval aviator. Reader's Digest reprinted his first P.A. piece. The card also contained promise of "some excellent material" from over there. We've got our fingers crossed.

* * *

SOME day we're going to get our first ride in a seaplane. We want to now, more than ever, after working on "Seaplaning Is Fun!" with Mr. Kurt (page 20). Just recalling some of the flights we've made in landplanes is enough to make us take an active interest in the pontoon-equipped jobs Just think: here at Chicago, we could take off of Lake Michigan (four blocks from our office) and fly all the way up into Canada for a week-end or an entire vacation—and we'd have a safe landing under us every minute. We could stop at practically any town along the way that looked interesting. Or go fishing out the cockpit window. Or swimming off a pontoon.

* * *

WE'RE definitely planning to visit Bill Piper now. We'd always intended to, but "Cubs' Den" on page 14 cinched it; we've just got to see the place and the man responsible for it. Trouble is, the Piper plant almost *is* a den, it's so hard to get to. Nearest airline stop is Williamsport, Pa., and that's been discontinued for the time being. Of course, we *might* consider riding a train for the sixth time in our lives.

* * *

But we're afraid of 'em. M.K.

END

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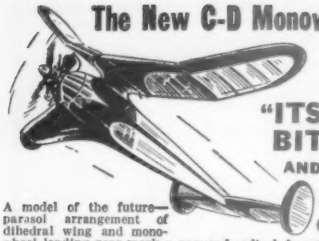

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(*Continued from page* 92)

color-coated so the workmen know exactly where each piece fits in the plane.

In the paint shop a huge ferris wheel is employed. Wings and fuselages are hung on ingeniously-designed cars on the wheel and painters are busy paint-spraying wings and fuselages at the bottom of the wheel while those above are drying and gradually working down for their next coats.

The first floor of the factory is divided into two assembly lines. On one side are the *Coupes* and on the other the trainers and sports. In the line one currently will find a number of ships being built for Civil Aeronautics Authority inspectors, for foreign owners and others.

"The C. A. A. likes our ships," Piper explains. "That's why they're putting them out to their inspectors."

The *Cubs* emerge from the factory at one end, completed and ready to be test flown—or ready to be loaded into box cars for shipment. But most ships are flown away, sometimes in bunches of 10 to 15 at a time.

Which in itself is ample illustration of Piper's growth.

END

Landing Gears

(*Continued from page* 59)

by a combination of both directions. Section 3 shows the retraction mechanism composed of two spindles operated by bevel gears. Section 4 illustrates a mechanism used to move the gear into the fuselage by a hydraulic jack. The hydraulic jack simplifies the design; however, it may add to the discomfort of the passengers if operated at maximum speed.

The use of a worm gear drive is indicated in Section 5. It moves the cantilever landing gear laterally into the hollow of the wing and the attached plates cover the opening in the retracted position. In low-wing airplanes the wheels are usually located below the front beam and retracting it about an axis vertical to the beams would add intricate cut-outs to the front beam. Sloping the axis permits the retraction between the beams, if the graphic layout is followed as shown in Section 5.

The protrusion of a wheel when retracting it longitudinally may be eliminated by rotating it 90 deg. A design shown in the lower figure in Section 6 is one solution of the problem. One miter gear is fastened to the wing and the other to the shock strut. If the unit is moved through a 90 deg. angle the wheel will be in a horizontal position.

Section 7 shows a design using a segment and a worm gear drive without rotating the shock strut. The advantage of a worm drive is the self-locking characteristics in the up and down position if a low-pitch drive is used. The lower figure in Section 7 indicates a retraction mechanism with a longitudinal movement followed by a lateral one. This design requires only a few parts and may prove suitable for lightplanes.

Usually the plunger of a shock-absorber strut is guided by the cylinder to prevent an angular displacement. This is accomplished by milling grooves into the cylinder and attaching a grooved disc to the plunger as sketched in Section 8. It may cost less to mill the grooves onto the plunger and have the guiding disc secured to the cylinder, but it will be not so easy to seal against leaks. Also, a protective sleeve must be added to prevent dust settling on the grooves. Connecting the cylinder and the plunger with a hinge or hinges as shown in Section 8 reduces the manufacturing cost to a minimum.

Designing retractable landing gears requires a thorough knowledge of available manufacturing facilities and manufacturing methods. Carefully detailed drawings showing the landing gear in various position of retraction with all forces acting on each member must be made.

There are also a few principles that must be followed when designing retractable landing gears. All axes must be parallel to each other to eliminate rotative movements. If the axes are not parallel, a ball-and-socket joint must be used to take care of the rotative motion; a universal joint will not be suitable.

Another point of investigation is to see that the extended strut stays closed when subjected to landing shocks. A sketch in Section 9 shows the correct position of the hinge in order to stay closed against gravity. All landing gears should be locked in the up and down position and should be equipped with a positive release unit.

If the landing gear is to be extended by gravity, a careful check must show that the component of the air pressure is not greater than the weight component, else the landing gear cannot extend fully.

Section 10 illustrates in three sketches the action of a hinged rear strut of a retractable landing gear. Section 11 pictures a design used in large transport planes actuated by hydraulic or compressed air jacks. A shock cord secures the gear in the up and in the down positions. The upper figure in Section 12 shows a horizontal retraction with a spindle actuated by bevel gears. The lower sketch in Section 12 places a compact retraction unit right at the hinge of the rear strut; this unit is a combination of gears operated by an electric motor.

Until lately it has not been thought necessary to retract the tail wheel, for it was always exposed to a disturbed airstream. Better streamlining of the fuselage however showed that retracting the tail wheel will increase the top speed. Tests showed that an unfaired tail wheel has the same resistance as one streamlined cantilever landing strut. Section 13 shows two sketches of retractable tail wheels. The design is usually similar to that of the main landing gear.

Amphibians always had retractable landing gears that were only raised out off the water. Lately however they are concealed within the structure to improve performances. Sketches in Section 14 indicates the locations of these re-

tracted gears. Some high-powered flying boats retract their wing tip floats. There is a trend at present to retract the whole flotation gears of a hydroplane or of a flying boat as illustrated in Section 15.

The retractable landing gear design offers a very active field for specialization; it offers many problems to be solved that involves simplicity, weight and best aerodynamic performances.

END

I Learned About . . .

(*Continued from page* 51)

works. First it would rain. Then it sleeted. Then it just plain iced-up. My first scare, occasioned by the take-off, had pretty well worn off. So I said "What the hell!" and gave 'er the gun. Up went the altimeter needle to 19,000 feet, with the *Hornet* hollering bloody murder. Finally, I found myself between two cloud layers and right smackdab in the muckiest part of the nasty weather. Ice formed in the carburetor and the heater didn't even faze the stuff. At the risk of sending a cylinder head wingdinging off into the night like a rocket, I was finally forced to blow the rime out by backfiring my motor. Luckily, it worked.

All this time I was riding TWA's radio beam from Albuquerque to Amarillo. Then, so help me, the knob of my wireless receiver fell off and I *was* up the creek without a paddle. It was at this unhappy moment that I thought about bailing out. My earlier recollections, however, told me that what used to be a nice, soft dustbowl probably had been furrowed into something quite impossible to land on. They informed me, also, that the altitude of the ground down there was plenty high. Here I was, 200 pounds of Armistead, with a dinky little 24-foot parachute. As I did once before—when my engine had conked—I chose to ride 'er in. Somehow or other I got into Winslow in one piece.

The Gee Bee? Francisco Sarabia, president of a native Mexican airline that flies practically anywhere you want to go down there, bought it. And maybe it's the luck of the Latins—but Sarabia hopped from Los Angeles to Mexico City in the jalopy in six hours and 20 minutes. That's the first time the darned machine had ever finished a flight. . . . Then, not long ago, the jinx caught up with Sarabia. He was *drowned* when her engine quit on a take-off from a Washington, D. C., airport and dropped him into the Potomac River.

See what I mean by a lesson? Twenty minutes more of flying with that Gee Bee over Arizona and it would have been me instead of poor Sarabia. There are times when you have to say: "I've had enough!" It's tough, but it must be done. You wouldn't drive your automobile with a busted oil line. So you certainly shouldn't try it with an airplane that's all that intervenes between you and a 400 m.p.h. dive into Nowhere.

END

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WPAirports

(*Continued from page* 48)

in New Jersey, and Sand Point in Washington. National Guard airports improved by them included Roberts Field in Alabama, Camp Grant Field in Illinois, Stout Field in Indiana and Camp Douglas Field in Wisconsin.

Greatest of the WPA's air defense projects for the Army has been at McChord Field, where workmen excavated and graded more than a quarter of a million cubic yards of earth for the landing area, paved and asphalted 410,000 square yards of runways, built warming aprons totalling 162,370 square yards, laid five miles of streets, installed electrical and heating systems and put down thousands of feet of water and sewage pipe. Biggest job for the Navy was at Sand Point, where WPA labor erected all but two or three of the existing 35 buildings, including five hangars an administration building, a new south wing to the barracks, three homes for married officers and a new bachelor officers' quarters.

Dedicated to the ideal of peace, the very existence of these up-to-date military airports as potential instruments of defense is a strong guarantee of the nation's safety. The time may never come when they will be needed for military purpose but, if it does, they will be instantly available. In the meanwhile they will serve as a potent instrument in the work of promoting friendship, good-will and understanding between America and its neighbor nations.

Aviation—both military and commercial—is going to develop at least twice as fast, maybe five times as fast, in the 1940's as it did in the 1930's. To meet its growing requirements is a serious problem one which will have to be solved eventually. When motorists became numerous enough, we got good roads. Aviation must be served in its turn. The work of the WPA, extensive as it has been, still is only a good starter. With work-relief gradually slipping out of the picture, the need for a new program of airport development and extension soon will become acute. Just how we will meet it remains to be seen, but meet it we must and perhaps many of the techniques worked out by the WPA's shovel-leaning miracle workers will then stand us in good stead.

Certainly the achievement of these thousands of men, who otherwise might have been destitute and even desperate, constitutes the most important single contribution of the decade of the thirties to the national airport picture. Whether or not we of today give them the credit they are due, future generations will see their work and know now that it was good.

END

Heads Up, Soldier!

(*Continued from page* 34)

planes which drop them. The bomb still is the principal weapon of light bombardment as it was of attack aviation. It might be possible for the size of bomb demanded by the character of the target to be too large for an effective slow-up device such as a parachute, or the target might be such as to render a delay-fused bomb relatively ineffective. Should the attack be made against well-disciplined troops which are also well-organized with lookouts warning of the planes' approach, the successive plane formations might run into such a hail of lead from rifle and machine gun fire as to inflict unusually severe casualties.

Going up a little higher, the bombardment airplane need not be afraid of fragments from its own bombs, may also be above effective rifle fire and still too low for anti-aircraft gun fire. The *disadvantages* are cumulative, however, as the attacker loses his surprise effect and gives the defender time to get his small automatic weapons into play, while the plane is in their field of fire for a longer time than if he were flying lower.

A still higher altitude places the attacker above effective small arms and small automatic weapon fire, but at such altitude the large caliber anti-aircraft guns become effective. We may well ask the question, "which anti-aircraft guns, the ones the other side *hasn't* got?", for it is quite apparent that there will seldom be as many large anti-aircraft guns as there are places for them to defend against light bombardment attacks. Larger, heavier objectives, ordinarily subject to medium and heavy bombardment attacks may be the first to get their quotas of such guns.

Of course, at such an altitude the bomb sight must be brought into play but, considering the well-known superiority of the American bomb sight, this may well be considered an advantage rather than a disadvantage. There is still room here for enemy pursuit aviation to deliver effective attacks against light bombardment airplanes flying at such altitudes, but the light bombers are not too high that they cannot nose for the ground and streak away over the waves or three tops, thus placing the pursuit at a disadvantage.

In the expanded GHQ Air Force the two groups of light bombardment aviation are to be stationed at Barksdale Field. These are the 3rd and the 27th Groups, each composed of one headquarters and three tactical squadrons.

Notes: The opinions expressed herein are those of the author and not necessarily those of the War Department.

END

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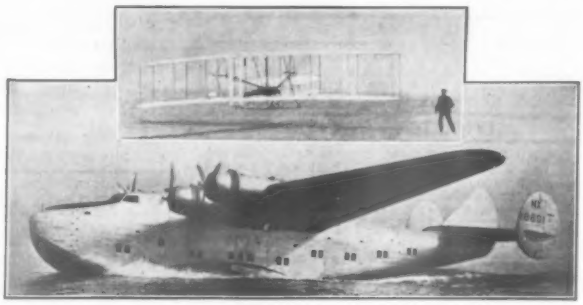

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